INSTRUCTION MANUAL

TYPE
RM 564
OSCILLOSCOPE

MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

INSTRUCTION MANUAL

Serial Number _____

This is the instruction manual for your new Tektronix instrument. It contains detailed information about the characteristics, operation, circuit description and calibration of your new instrument.

If you have any questions, your local Tektronix Field Engineer is ready to assist you in instrument selection, operation, application and maintenance. Take advantage of the product knowledge that our staff offers.

We would like to send you our technical publication, "Service Scope" on a regular basis. Please fill out the return card and drop it in the mail.

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TYPE
RM
564
OSCILLOSCOPE

Tektronix, Inc.
S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

070-415 1164

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

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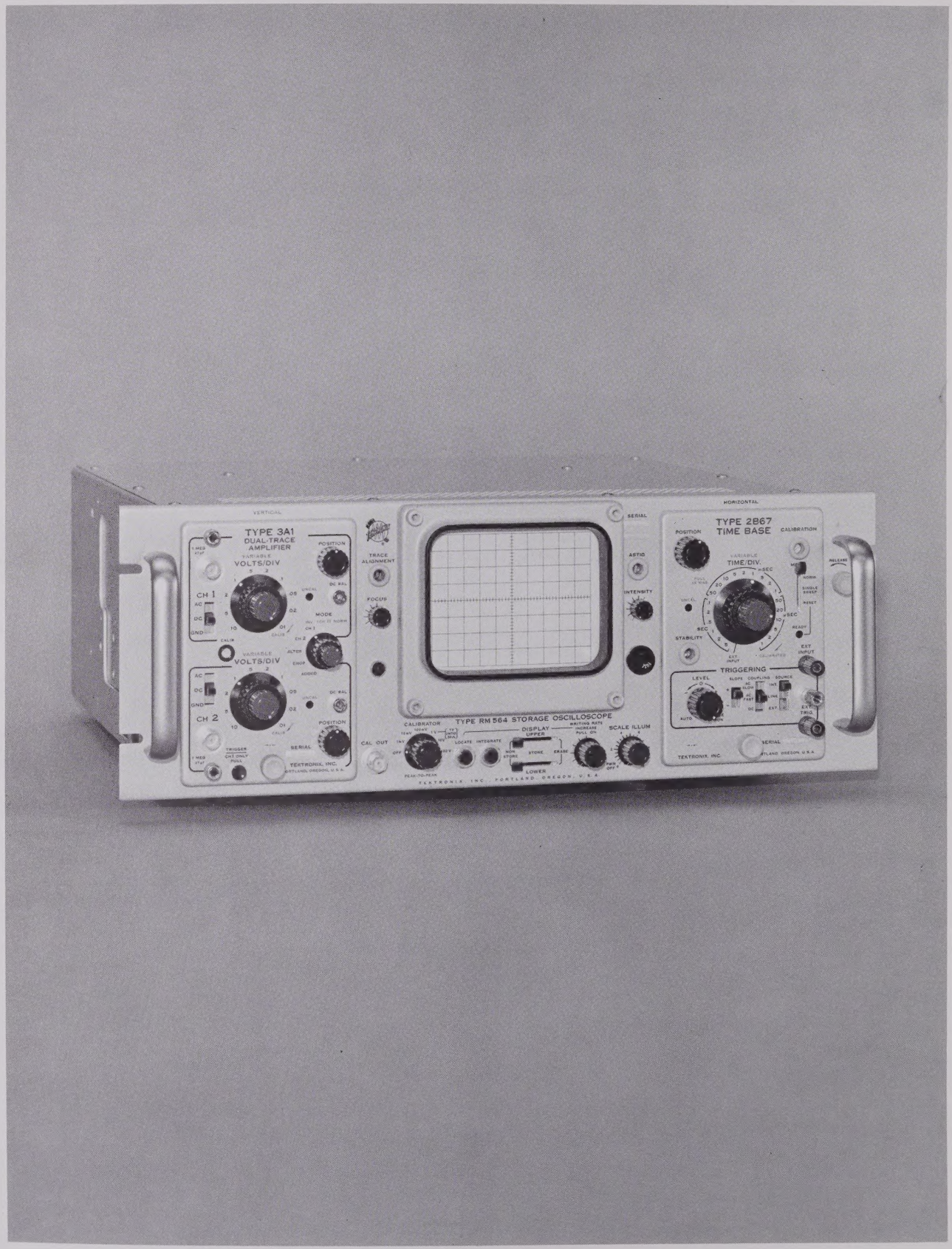
A list of abbreviations and symbols used in this manual will be found on page 6-1. Change information, if any, is located at the rear of the manual.


VERTICAL
TYPE 3A1
DUAL-TRACE
AMPLIFIER
VARIABLE
VOLTS/DIV
CH 1
CH 2
AC
DC
GND
POSITION
MODE
TRACE
ALIGNMENT
FOCUS
SERIAL
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.
TYPE RM564 STORAGE OSCILLOSCOPE
CALIBRATOR
CAL OUT
PEAK-TO-PEAK
DISPLAY
UPPER
LOWER
LOCATE
INTEGRATE
STORE
ERASE
WRITING RATE
SCALE ILLUM
ASTIG
INTENSITY
HORIZONTAL
TYPE 2B67
TIME BASE
CALIBRATION
TIME/DIV.
STABILITY
TRIGGERING
LEVEL
SLOPE
COUPLING
SOURCE
AUTO
NORM
SINGLE SWEEP
RESET
READY
EXT INPUT
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

SECTION 1
CHARACTERISTICS

General Description

The Type RM564 Storage Oscilloscope is a special-purpose oscilloscope designed to store cathode-ray tube displays for viewing or photographing up to an hour after application of the input signal. In addition, the instrument can be operated as a conventional oscilloscope. The physical dimensions of the Type RM564 permit it to be mounted in a standard 19-inch rack, using only 7 inches of vertical space. Since it is compatible with all Tektronix 2-Series and 3-Series plug-in units, the Type RM564 can be operated in a variety of modes including differential, multi-trace, wide-band, sampling and delayed sweep.

The two separate storage screens of the cathode-ray tube provide convenience and versatility for comparison and analysis of waveforms. Display storage is also convenient for photography and detailed viewing of single-sweep displays and extremely low-frequency waveforms (< 60 cps). You may use either the upper or lower storage screen in storage mode while the other screen is operated in non-store, or you may operate both screens together in either storage or non-store mode.

Cathode-Ray Storage Tube (Patents Pending)

Type—Tektronix-manufactured T5640-200 for the standard instrument; T5640-201 for the Type RM564 (Mod 08) Oscilloscope. The crt is warranted under the Tektronix instrument warranty given in the front of this manual.

Envelope—Rectangular, 4-inch x 5-inch ceramic and glass; flat glass faceplate.

Screen—8-cm × 10-cm viewing area divided into 4-cm × 10-cm upper and lower storage screens. Each screen has its own operating-level and erase circuitry for storage operation.

Accelerating Voltage—3.5 kv.

Deflection—Electrostatic.

Deflection-Plate Sensitivity—Horizontal: approximately 18.5 volts/cm. Vertical: approximately 19.5 volts/cm.

Unblanking—Deflection-type, dc-coupled; ±88 volts approximate cutoff.

Intensity Modulation—Internal: grid. External: cathode. Typically a 3-volt external signal will produce visible intensity modulation.

Focus—Electrostatic.

Storage Duration—At least one hour.

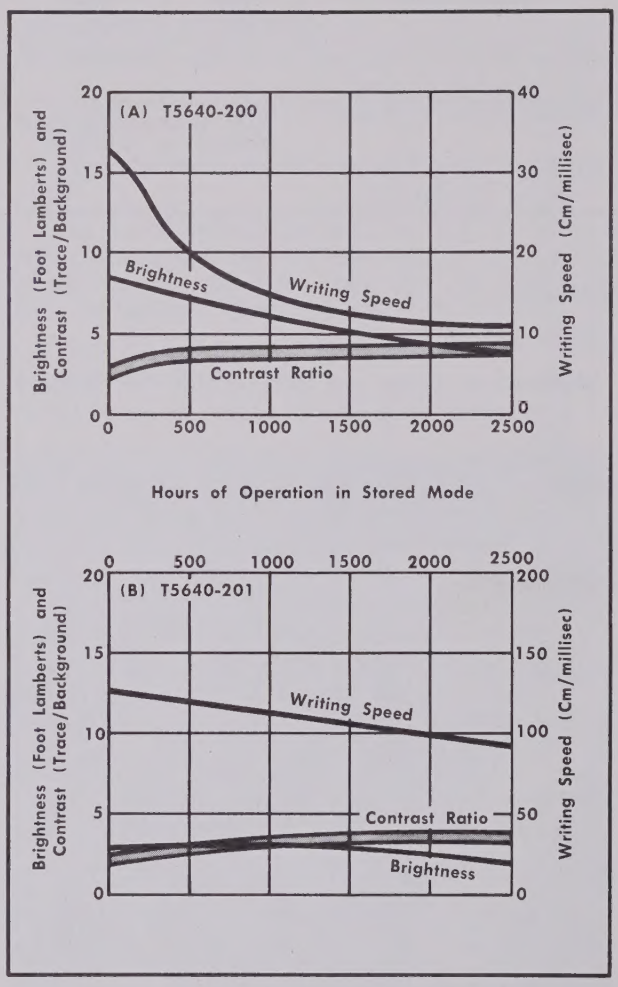


Fig. 1-1. Typical changes in writing speed, brightness and controls for the T5640-200 and T5640-201 crts.

Erase Modes—Manual: front-panel DISPLAY switches. Remote: rear-panel remote-erase jack. A 9-pin plug that mates with the remote-erase jack may be ordered through your Tektronix Field Office. Tektronix part number for the plug is 134-049.

Erase Time—Approximately 250 msec.

Writing Speed, Brightness and Contrast—See Table 1-1 for minimum performance specifications and Fig. 1-1 for expected crt life characteristics. The hours of operation shown are the hours the crt is used in the storage mode with repetitive writing, storing and erasing.

Writing Speed Increase (using trace enhancement)—Approximately 10:1 for T5640-200 crt; approximately 5:1 for T5640-201 crt.

TABLE 1-1

Storage Screen Specifications
(Center 6 x 8 cm area)

Characteristic	Type T5640-200	Type T5640-201
Minimum Initial Writing Speed (60 μamp beam current)	25 Cm/mSec	100 Cm/mSec
Minimum Initial Brightness	6-Foot-Lamberts	2-Foot-Lamberts
Minimum Display-to-Background Contrast Ratio	2:1	2:1

Graticule

Type—External.

Markings—8 vertical and 10 horizontal 1-cm divisions; 2-mm marks along the vertical and horizontal centerlines.

Illumination—Variable edge lighting adjusted with front-panel SCALE ILLUM control.

Calibrator

Waveform—Square-wave signal at power-line frequency.

Output Voltage—1 millivolt to 100 volts peak-to-peak in 6 calibrated decade steps; within 3% of indicated voltage into high-impedance load. Output amplitude at 1 V position is 0.1 volt into a 50-ohm load.

Risetime—5 μsec or less.

Instrument Power

Line Voltage—105 to 125 volts (117 volts nominal), or 210 to 250 volts (234 volts nominal), single-phase ac.

Line Frequency—50 to 60 cps.

Power Consumption (with plug-in units)—Maximum of 250 watts.

Fuse—3-amp slow-blowing type for 117-volt operation; 1.6-amp slow-blowing type for 234-volt operation.

Ventilation

Type—Forced-air cooling.

Overheat Protection—Thermal cutout interrupts instrument power if temperature exceeds safe operating level (ambient air 122° F maximum); restores power automatically when temperature drops below reset level of cutout (approximately 115° F).

Mechanical Characteristics

Construction—Aluminum-alloy chassis and panels. Top and bottom panels separately removable. Photo-etched anodized front panel.

Dimensions—Height: 7 inches. Width: 19 inches. Depth: 20½ inches, excluding right-angle power cord. Additional dimensional information may be found on the Dimension Drawing foldout sheet at the rear of this manual.

Weight—31 pounds without plug-in units.

Standard Accessories

1—Polarized viewer, 016-039.

1—3-wire power cord, 161-013.

2—Instruction manuals, 070-415.

1—3- to 2-wire adapter, 103-013.

1—BNC to BNC Patch Cord, 012-0087-00.

1—BNC to Banana Patch Cord, 012-0091-00.

1—BNC to Post Jack, 012-0092-00.

Optional Accessories Available

Slideout track mounting assembly (Mod 171), 351-050.

Cradle mounting assembly, 040-344.

Blank plug-in unit, 040-245.

See current Tektronix catalog for 2-Series and 3-Series plug-in units.

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SECTION 2

OPERATING INSTRUCTIONS

General Information

All controls and connectors required for operation of the Type RM564 Storage Oscilloscope are located on the front and rear panels of the oscilloscope and the front panels of the plug-in units. To be able to fully utilize the capabilities of the instrument, you should first familiarize yourself with the control functions and the various modes of operation. Basic operation of the Type RM564 indicator unit is discussed in this section, and the storage modes of operation are illustrated in the form of demonstrations.

The oscilloscope crt display is formed in the same manner as that of a conventional oscilloscope, normally using a repetitive time-base sweep for horizontal deflection of the crt beam while the input voltage signal is displayed as vertical deflection. The amount of vertical displacement (input deflection factor) for any given input voltage is selected with the Volts/Div switch and Variable control on the amplifier plug-in unit. The rate of horizontal deflection (sweep rate) is selected by means of the Time/Div switch and Variable control on the time-base plug-in unit. Triggering of the sweep is provided by the time-base unit to start each sweep at the same point on the repetitive waveform. For detailed operation of the amplifier and time-base plug-in units, refer to the instruction manuals for the particular units.

In addition to displaying the input signal(s), the Type RM564 is also able to store waveform displays so they will remain on the oscilloscope screen for extended periods of time. The two storage screens that make up the crt screen can be operated either independently (with respect to storage) or together, in either storage or non-store mode.

INSTALLATION

Rackmounting

Methods and instructions for rackmount installation of the Type RM564 are given on the Rackmounting fold-out sheets in the rear of this manual. Tektronix part numbers for ordering rackmount assemblies are given in the Characteristics section (Section 1) under Optional Accessories Available.

Cooling

A fan at the rear of the Type RM564 provides forced-air cooling of the instrument. The entire snap-in fan assembly can be mounted to operate either as an intake fan or an exhaust fan. When mounted as an intake fan, the air is drawn in from behind the instrument and is blown out the holes in the top and bottom panels. When mounted as an exhaust fan, the air is drawn in through the top and bottom panels and is blown out into the space behind the instrument. The direction of air flow should be selected to provide the best cooling, depending on the air temperature behind, above and below the instrument, and on the direction of air flow through adjacent instruments. In general, all instruments in one rack should have the same direction of air flow to prevent recirculation of overheated air. Some method of ventilation should be provided for removal or cooling of the heated air.

To reverse the fan assembly, and thus the direction of air flow, proceed as follows:

1. Snap the air screen out of the rear panel of the Type RM564.

2. Pry the fan-assembly retaining clips (Fig. 2-1) outward with a screwdriver, one at a time, until the clip tabs disengage from the assembly. While each clip is held out, press the assembly toward the rear of the instrument.

3. Slide the fan assembly out of the oscilloscope, but do not disconnect the fan wires.

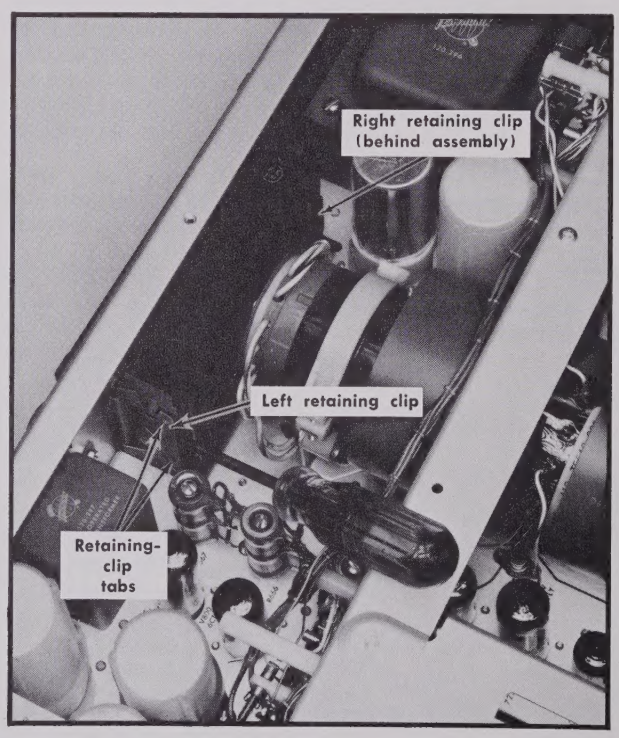

Fig. 2-1. Removal of fan assembly. Pry each retaining clip outward with screwdriver until tabs disengage.

4. Turn the assembly around (same side up) and reinsert it into the mounting clips. Be sure the slots in the fan assembly are aligned with the flanges on the mounting clips.

5. Press the assembly in (forward) until it snaps firmly into place.

6. Replace the air screen. Both sides of the air screen holder must be pressed in at the same time so the tapered tabs will slide under the retaining clips.

The Type RM564 can be operated in ambient temperatures up to 122° F. If the internal temperature becomes too high, a thermal cutout will open and disconnect power until the temperature has returned to normal. If this occurs, check that the air circulation and ventilation are adequate. A constant temperature is important for accurate operation of the instrument. If wired for 117 volts, the fan will operate even if the thermal cutout disconnects power from the rest of the instrument. If connected for 234 volts, the fan will not operate with the thermal cutout open.

Transformer Conversion

This instrument is wired to operate on the line voltage indicated on a metal tag adjacent to the power plug. Line frequency must be between 50 and 60 cps. The transformer primary is designed for convenient conversion to either 117 volts of 234 volts nominal line voltage. To convert from one voltage to the other, change the transformer primary and fan wiring connections as shown in Fig. 2-2 and change the power-line fuse as indicated on the right-side panel of the instrument. When the transformer connections are changed, the voltage tag next to the power plug should also be changed. This may be done by replacing the old tag or covering it with one conforming to the new operating voltage (Tektronix part number 334-649 for 117V tag; 334-655 for 234V tag), or by reversing the old tag and painting the new voltage on the blank side.

For instruments S/N 101-149, the wiring arrangement on the ceramic strip was slightly different from that illustrated. In some of these instruments, 117 volts ac was not supplied to the plug-in units (pins 7 and 8) when wired for 234 volts. If desired, these instruments may be changed by reconnecting the bus wires and transformer leads as indicated.

SELECTION OF PLUG-IN UNITS

General Information

The Type RM564 Oscilloscope is designed to use Tektronix 2-Series and 3-Series amplifier and time-base plug-in units to amplify the vertical input signal and to generate the time-base sweep. The use of plug-in units permits the selection of display modes, bandpass, sensitivity and number of inputs required for your particular application.

Changing Plug-In Units

To install a plug-in unit in the Type RM564, push it all the way into the plug-in compartment, then turn the locking knob (at the bottom of the front panel) clockwise until it is tight. To remove the unit, turn the knob counterclockwise until the latch releases, then pull out the unit.

Plug-in units can be exchanged without turning off the instrument power, however it is recommended that the power be turned off to protect the units from transient voltage surges and as a precaution against storage tube burning.

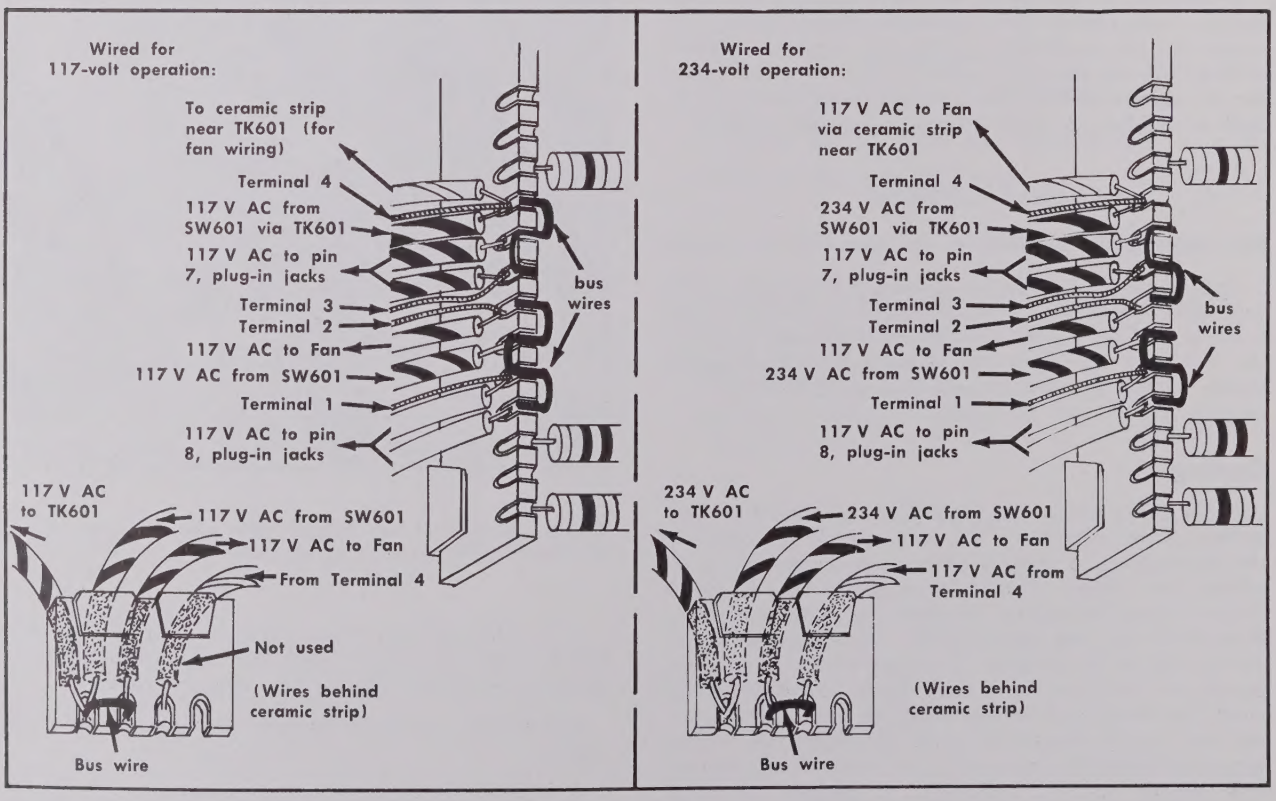

Fig. 2-2. Transformer primary and fan connections on bottom of instrument. Change only the bus wires for conversion. (See text for instruments S/N 101-149.)

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CAUTION

Always turn the INTENSITY control fully counterclockwise while exchanging plug-in units, whether the power is left on or turned off. Increase the intensity only after the plug-in unit has had about ½ minute to warm up.

The accuracy of measurements made with the Type RM564 depends on the calibration of the plug-in units used. Since the plug-in units drive the deflection plates directly, each unit must be adjusted to match the deflection sensitivity of the particular set of deflection plates that it drives. Therefore, the gain or sweep timing adjustment must be checked each time a plug-in unit is changed. On most units, gain or timing calibration is made with a front-panel screwdriver adjustment. (Sampling units require special adjustment procedures.) Refer to the plug-in unit instruction manual for the required procedure. Since the various plug-in units present different output voltage levels to the deflection plates, the FOCUS and ASTIG controls will also require readjustment.

Either or both of the plug-in units can be operated on special extension cables (Tektronix part number 012-066) for circuit checking. For normal operation, however, the units should be installed in the oscilloscope. If the instrument is operated with the plug-in units on extension cables, the high-frequency response and fast sweep rates will be affected slightly.

Display Combinations

The plug-in unit in the left plug-in compartment controls the vertical (Y-axis) deflection of the crt beam, and the unit in the right plug-in compartment controls the horizontal (X-axis) deflection. To produce a normal time-base display, an amplifier plug-in unit is used in the vertical plug-in compartment and a time-base plug-in unit is used in the horizontal plug-in compartment.

The most desirable combination of plug-in units for most storage applications is that of a dual-trace amplifier unit with a time-base unit capable of single-sweep operation. The single-sweep capability allows the sweep to be held off while the signal is repositioned or while a stored display is viewed, without changing the settings of any other controls.

The use of a dual-trace or multi-trace amplifier unit permits simultaneous viewing of two or more signals. For a multi-trace amplifier unit with single-channel trigger capability ("Channel 1 Trigger"), the trigger signal is applied through the Type RM564 to the trigger circuit of the time-base unit. This permits internal triggering from a single input signal and the crt display shows the time relationship between the various signals. Without single-channel triggering, an external trigger is required to establish time relationships in multi-trace displays. In chopped mode, the multi-trace blanking pulses from the amplifier unit are applied internally through the Type RM564 to the crt cathode (with the rear-panel CRT CATHODE SELECTOR switch at CHOPPED BLANKING) to blank the crt beam while it is switched from one channel to another.

A delayed-sweep time-base unit may be used for detailed viewing of pulse-train segments that occur a relatively long time after the maximum-amplitude (triggering) portion of the signal. The portion of the pulse train to be displayed by the delayed sweep may be intensified on the delaying-sweep display. A delayed-sweep unit that has a calibrated time delay can also be used for making very accurate time measurements.

Other combinations of plug-in units can be used for other types of displays. For example, two amplifier units may be used to produce an X-Y display for phase comparison measurements. Plug-in units with equal phase shift will produce an accurate X-Y display.

The amplifier and time-base units may also be interchanged to produce a display with vertical sweep. If a vertical sweep is used, however, there is no retrace blanking, delaying-sweep intensification does not operate and the LOCATE pushbutton does not function.

The equivalent bandpass of the oscilloscope can be increased to as much as 1 gigacycle through the use of sampling plug-in units. A sampling time-base unit must be used with a sampling amplifier unit in the Type RM564 to produce the sampling display (even for X-Y operation). Sampling and conventional plug-in units cannot be used together in the oscilloscope.

For special applications, the Type RM564 can be operated with only one plug-in unit installed. When this is done, the set of deflection plates that is not connected to a plug-in unit must have dc voltages of approximately +180 volts applied to them from a low-impedance source (20 k or less) to permit focusing of the display. If the source impedance is too high, flood-gun current will cause incorrect operation of the crt.

Custom Plug-In Units

Blank-chassis plug-in units can be purchased through your local Tektronix Field Office as Modification Kit number 040-245. These blank chassis permit you to build your own plug-in circuitry for use in the Type RM564. The power drawn from any of the regulated supplies should not exceed that of standard plug-in units. However, the nature of series-regulated power supplies permit the use of some additional current by placing a shunt resistor of appropriate value across the series regulator tube. Use Table 2-1 as a guide for selecting the shunt resistors if additional current is required.

The value of the shunt resistor must be chosen to permit the regulator system to deliver current with low ripple, and the resistor must have a power rating high enough to carry its share of current without overheating. Current limits of the —100-volt, +125-volt, and +300-volt dc supplies are given in Table 2-1. Do not shunt any other supply.

To use the —12.2-volt regulated heater supply on your own plug-in unit design, run two parallel leads from pins 5 and 16 of the interconnecting plug to the heater pins, to avoid chassis ground currents. Up to 800 ma of current is available from the —12.2-volt supply.

TABLE 2-1

Power Supply Current Limits

Shunt Resistor Value	Available Current		
	—100-volt Supply, Pins 22 and 9	+125-volt Supply, Pins 20 and 15	+300-volt Supply, Pins 6 and 10
No Shunt	0 to 25 ma	0 to 45 ma	0 to 40 ma
2 kΩ, 5 w between pins	20 to 45 ma	25 to 60 ma	35 to 67 ma
Short between pins	40 to 65 ma	50 to 75 ma	65 to 70 ma

FUNCTIONS OF CONTROLS AND CONNECTORS

Controls and connectors on the front and rear panels of the Type RM564 are shown in Fig. 2-3.

FRONT PANEL

TRACE ALIGNMENT Control — Rotates crt display to align it with horizontal graticule markings. Check trace alignment after moving instrument, since alignment is affected by earth's magnetic field.

FOCUS Control — In conjunction with ASTIG control, adjusts focus of spot or trace. For most displays, only adjustment of the FOCUS control is required.

Pilot Light — Indicates that ac power is applied to low-voltage supplies.

ASTIG Adjustment — In conjunction with FOCUS control, adjusts focus of spot or trace. Set ASTIG adjustment for minimum trace width or spot diameter after FOCUS control has been adjusted for **equal** vertical and horizontal focus.

INTENSITY Control — Adjusts writing-gun display brightness to allow for different sweep or triggering rates. Rotate control clockwise to increase display brightness; counterclockwise to decrease brightness. (Does not change brightness of stored display.)

CAUTION

Excessive intensity can damage the storage screen. Use minimum intensity necessary to view or store the display. See the precautionary suggestions given below under "Care of Storage Screens".

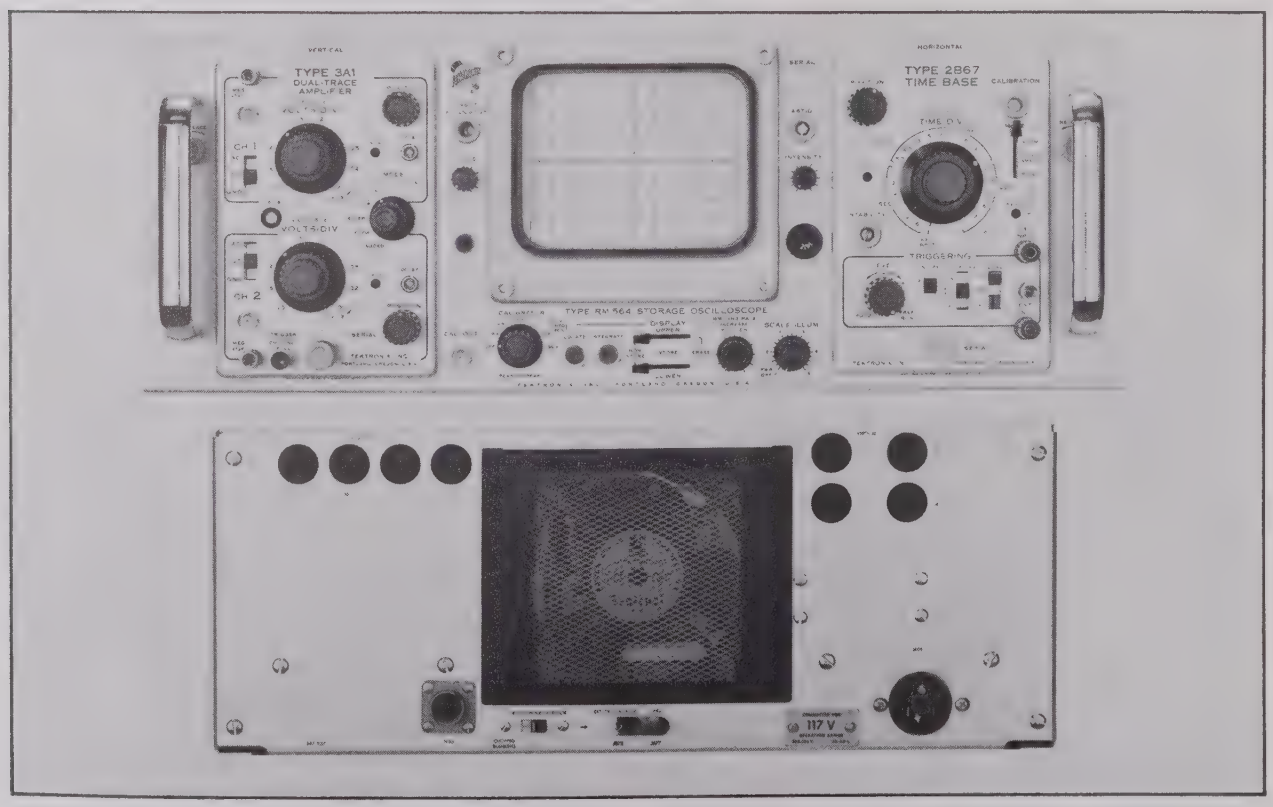


Fig. 2-3. Front- and rear-panel controls and connectors.

Fuse	Limits power transformer primary current to prevent overload. Always use correct fuse for your line voltage, as indicated on right side of chassis.
CAL OUT Connector	Provides Calibrator square-wave output for checking gain of amplifier units and for adjusting probe compensation (use dc-coupling at vertical input). Amplitude of output signal is controlled by CALIBRATOR switch.
CALIBRATOR Switch	Sets amplitude of power-line frequency square-wave signal available at CAL OUT connector; turns off Calibrator when knob is turned fully counterclockwise. Peak-to-peak square-wave amplitude is selected from 6 calibrated decade steps ranging from 1 millivolt to 100 volts into high impedance (1 megohm or more); amplitude is 0.1 volt at 1 V position when CAL OUT is terminated in 50 Ω.
LOCATE Pushbutton Switch	Displays a dot or line in the non-storing area at left edge of screen to locate vertical position of signal while sweep is held off. This permits display to be positioned before storing.
INTEGRATE Pushbutton Switch	Permits storage of repetitive displays that exceed the normal writing speed of the storage screens.
Upper DISPLAY Switch	Selects storage (STORE) or non-store (NON STORE) mode of operation for upper half of crt screen; erases stored display when switch is pressed to ERASE, then released.
Lower DISPLAY Switch	Selects storage (STORE) or non-store (NON STORE) mode of operation for lower half of crt screen; erases stored display when switch is pressed to ERASE, then released.
WRITING RATE INCREASE (PULL ON) Switch and Control	Permits storage of non-repetitive events beyond the normal writing speed of the storage screens.
SCALE ILLUM Control and Power Switch	Applies line power to low-voltage transformer; controls intensity of graticule illumination. Rotate control clockwise to turn on instrument and increase illumination; rotate counterclockwise to decrease illumination and turn off instrument (PWR OFF position).

REAR PANEL

Horizontal and Vertical Connector Holes	Permit installation of auxiliary inputs and outputs through rear panel.
Remote-Erase Jack (J950)	Permits remote operation of either or both erase circuits. Connect ground path or apply 5- to 10-volt negative pulse to appropriate pin of J950 (upper screen—pin A; lower screen—pin B). Chassis ground is provided through pin D.
CRT CATHODE SELECTOR Switch	Selects intensity modulation from dual-trace amplifier chopped circuit (with switch at CHOPPED BLANKING) or from external signal applied through EXT CRT CATHODE jack (with switch at EXT CRT CATHODE). Leave switch at EXT CRT CATHODE except when using chopped mode.
EXT CRT CATHODE Jack (J878)	Permits application of external signal (ac-coupled) for intensity modulation. Positive-going voltage signal decreases intensity; negative-going signal increases intensity. A 3-volt change will produce appreciable modulation. Remove grounding bar and set CRT CATHODE SELECTOR switch to EXT CRT CATHODE position when applying external signal.
GND Jack (J877)	Provides chassis ground for EXT CRT CATHODE jack to eliminate stray intensity modulation when no external signal is being applied.
Power Plug (J601)	Applies line voltage through power switch and fuse to power transformer primary. Third pin of plug is connected to chassis ground.

Calibrated Graticule

The edge-lighted graticule is accurately marked with 10 horizontal and 8 vertical 1-centimeter divisions and has 2-millimeter subdivisions on the vertical and horizontal centerlines. The gain and timing of the plug-in units are calibrated to these graticule marks, thus the marks provide a calibrated scale for making voltage and time measurements.

CAUTION

Never operate the instrument without a graticule or implosion shield in front of the crt.

Positioning and Deflection Controls

All of the controls related to vertical and horizontal deflection and positioning are contained in plug-in units. Refer to the instruction manuals of the specific units for operation of these controls.

FIRST-TIME OPERATION

The following procedure, using normal single-channel time-base mode, illustrates the basic operation of the Type RM564 and its plug-in units.

1. Install a 2-Series or 3-Series amplifier plug-in unit in the vertical (left) plug-in compartment and a 2-Series or 3-Series time-base plug-in unit in the horizontal (right) plug-in compartment. Lock the plug-in units in place with their locking screws.

2. With the SCALE ILLUM control set to PWR OFF, connect the power cord from the Type RM564 to the proper line voltage, indicated on the tag adjacent to the power plug.

NOTE

If the instrument is wired for 117 volts, it will operate properly from 105 to 125 volts. If wired for 234 volts, it will operate from 210 to 250 volts.

3. Install the polarized viewing hood on the graticule cover. The rivet through the top of the hood fits into the hole in the top of graticule cover flange.

4. Set the instrument controls as follows:

TYPE RM564

CRT CATHODE SELECTOR	EXT CRT CATHODE
FOCUS	Centered
INTENSITY	Counterclockwise
CALIBRATOR	1 V
Upper DISPLAY	NON STORE
Lower DISPLAY	NON STORE
WRITING RATE INCREASE	Off (pushed in)

Amplifier Unit

Position	Centered
Mode	Normal (Channel 1)
Volts/Div	1
Variable	Calibrated
Input Coupling	DC

Time-Base Unit

Position	Centered
Time/Div	5 msec
Variable	Calibrated
Magnifier	Off
Sweep Mode	Normal
Level	Free Run
Triggering Source	Internal
Slope	+
Coupling	AC

5. Connect a coaxial cable from the CAL OUT connector to the input connector of the amplifier plug-in unit (Channel 1).

6. Turn on the power switch (SCALE ILLUM) and allow a few minutes for warm up.

7. Adjust the INTENSITY control to obtain a display of moderate brightness. The amplifier unit Position control may have to be readjusted to position the free-running trace on the crt screen. Do not turn the intensity higher than is necessary for adquate observation of the display.

8. Trigger the display with the time-base Level control.

9. Set the SCALE ILLUM control so the graticule illumination is approximately equal to the intensity of the display.

10. Adjust the time-base Position control to position the start of the trace at the left edge of the graticule.

11. Adjust the FOCUS control for sharpest focus of the trace.

12. With a screwdriver, adjust the TRACE ALIGNMENT control to align the display with the horizontal graticule lines.

13. Check the gain and dc balance of the amplifier unit and the timing adjustment of the time-base unit as given in the instruction manuals for these units before making any voltage or time measurements.

Adjust Astigmatism

For most displays, the writing-beam trace can be adequately focused using only the front-panel FOCUS control. However, whenever a large change is made in the beam intensity (to offset large changes in sweep rates or triggering repetition rates), adjustment of the ASTIG control may also be required for a sharp display.

To set the ASTIG adjustment:

1. Connect the signal to be observed to the input of the amplifier plug-in unit.

2. Set the vertical and horizontal controls for the desired display. (Upper and Lower DISPLAY switches should be at NON STORE.)

3. Set the INTENSITY control for normal display intensity, i.e., for the minimum intensity level required to produce an adequate display.

4. Set the FOCUS control for **equal** focus of the vertical and horizontal portions of the signal.

5. With a screwdriver, adjust the front-panel ASTIG control for best overall focus of the display.

6. Repeat steps 4 and 5 to be sure the adjustment is correct.

Check Operating Level

The operating level (storage level) of the storage screens should be checked after each 300 hours of operation to ensure optimum storage operation at all times. See the Storage Circuit portion of the calibration procedure for the storage level adjustment.

CARE OF STORAGE SCREENS

CAUTION

Excessive writing-beam current can cause permanent damage to the storage target, therefore care must be exercised when setting the writing-beam intensity.

To prolong the useful life of the storage screens, always observe the following precautions when operating the Type RM564:

1. USE MINIMUM BEAM INTENSITY required to produce a clear, well-defined display. Special care should be taken during warm up and when using slow sweep rates or sampling displays.

2. TURN INTENSITY CONTROL TO MINIMUM WHEN CHANGING PLUG-IN UNITS. An undeflected spot on the crt screen can burn the storage target, even at normal intensity.

3. DO NOT INCREASE BEAM INTENSITY TO STORE FAST-CHANGING PORTIONS OF WAVEFORM. See instructions given later in this section for storing fast-rise waveforms.

4. DO NOT LEAVE DISPLAY ON CRT SCREEN (either writing or stored) when the display is not needed.

5. DO NOT LEAVE DISPLAY SWITCHES AT STORE when storage mode is not needed.

6. AVOID REPEATED USE OF THE SAME AREA of the screen.

Due to the nature of the storage screens, certain dim waveform images may appear to remain on the screens even after they have been "erased" with the DISPLAY switches. These images generally fall into the following three categories:

1. "Negative image"—A dark waveform image that appears as a darker background light level when the DISPLAY switches are set to STORE. Negative images result from writing or storing a waveform in one position on the screen for a relatively long period of time. They will usually disappear in a short time, but may temporarily decrease the writing speed of the affected area.

2. "Bright burn"—A bright waveform image that is visible when the storage screens are set to the fade-positive level*. Bright burns are caused by excessive intensity of the writing-gun beam. Severe burns may remain indefinitely.

NOTE

The appearance of a damaged target can sometimes be improved by adjusting the backplate voltage to the fade-positive level* and leaving it there for about 30 minutes. However, unless the residual images are causing annoyance, it is best to allow them to disappear gradually. Extended fade-positive operation decreases the stored-mode life expectancy.

3. "Dark Burn"—A spot or line on the screen that will not write or store a trace. Dark burns result from destructive burning of the storage target by the writing-gun beam. This type of burn is the same as phosphor burn in a conventional crt. Replacement of the storage tube will be required if dark burns impair operation of the instrument.

NON-STORE OPERATION

Operation of the Type RM564 in the non-store mode is essentially the same as that of a conventional general-purpose oscilloscope. The various display modes that are possible with a particular pair of plug-in units are described in the instruction manuals for those units. Also refer to the amplifier unit manual for the following: compensation of probes; selection and use of input cables, coupling and attenuation; measurement of input signal voltage and phase (X-Y). Refer to the time-base unit manual for selection of triggering sources and coupling and for measurement of time intervals, frequency and phase (linear measurement).

***Fade-positive level: Storage-target backplate voltage that causes the entire screen background to appear bright (stored). See "Storage Circuits" portion of the calibration section for fade-positive procedure.**

STORAGE MODE

In the storage mode, the writing-gun and deflection ciruits operate the same as in non-store mode. However, the storage circuits and storage controls are unique and require operating information not given in the plug-in unit manuals. The following demonstrations are intended to illustrate the various types of stored displays and the techniques required to obtain them.

Repetitive-Sweep Storage

Slow and Medium Sweep Rates

This method of storage is used for repetitive waveforms that produce normally bright displays on the crt screen.

1. Set up a calibrator waveform display as described in "First-Time Operation".

2. Center the waveform vertically on the crt screen so that part of the waveform is above the horizontal centerline and part of it is below the centerline.

3. Turn the INTENSITY control fully counterclockwise.

4. Press both DISPLAY switches to ERASE, then release them to STORE position. The normal storage-mode background light level will be present on the storage screens.

5. Advance the INTENSITY control slowly in the clockwise direction to produce a waveform display of normal intensity, then return the control to the minimum (counterclockwise) position. A stored waveform of moderate brightness should remain.

6. Press the Upper DISPLAY switch to ERASE and release it. Note that only the portion of the stored image on the upper storage screen (the upper half of the crt screen) has been erased.

7. Set the Upper DISPLAY switch to NON STORE. The image on the lower screen will not be affected when the upper screen is switched to non-store mode.

8. Press the Lower DISPLAY switch to ERASE and release it. The remainder of the stored image is now erased.

9. Set the Lower DISPLAY switch to NON STORE.

10. Increase the intensity to produce a normal display.

11. With the amplifier unit Position control, position the entire waveform onto the upper screen.

12. Turn the INTENSITY control fully counterclockwise.

13. Press only the Upper DISPLAY switch to ERASE and release it.

14. Increase the INTENSITY control to the normal display level, then return it to the minimum position. The waveform is now stored on the upper screen only, operating independently.

15. The demonstration may be repeated using only the lower screen in storage mode.

16. At the end of the demonstration, set both DISPLAY switches to NON STORE.

NOTE

Whenever one of the DISPLAY switches is moved from NON STORE to STORE, press it to the ERASE position momentarily before storing a display.

Repetitive Trace Location

The LOCATE button permits the trace to be located while the sweep is held off, so that it can be positioned to a new level before storing.

1. Set up a non-store calibrator display as in "First-Time Operation".

2. Store a display on the upper screen only, as in the preceding demonstration. (The Lower DISPLAY switch should be at NON STORE.)

3. Set the time-base Mode switch to Single Sweep.

4. Press the LOCATE pushbutton and hold it in.

5. Advance the INTENSITY control slowly until two dots of normal intensity appear at the left edge of the stored waveform.

6. With the LOCATE button still held in, turn the amplifier unit Position control to position the two dots to the left edge of the lower storage screen (see Fig. 2-4).

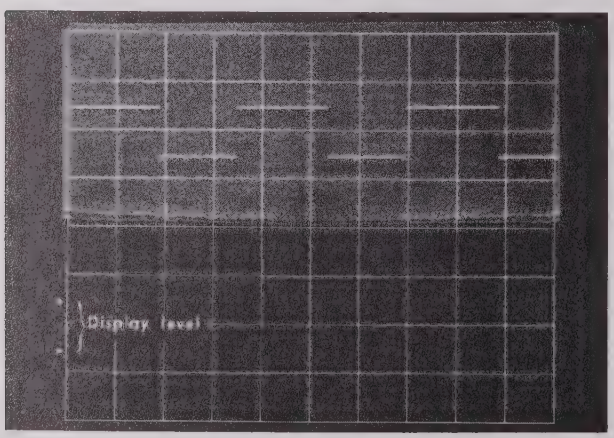


Fig. 2-4. Use of the LOCATE button for positioning the display level while the sweep is held off.

7. Release the LOCATE button.

8. Set the time-base Mode switch to Normal. The waveform on the lower screen is now displayed in non-store mode while the upper screen is in storage mode.

9. Turn the INTENSITY control fully counterclockwise.

10. Press the Lower DISPLAY switch to ERASE and release it.

11. Increase the intensity to normal, then return the INTENSITY control to the minimum position. Both screens should now have stored calibrator waveforms.

12. At the end of the demonstration, set both DISPLAY switches to NON STORE.

NOTE

For positioning repetitive displays, always turn off the sweep (Mode to Single Sweep) before pressing the LOCATE button. Also be sure the sweep starts at the left edge of the graticule. When the sweep magnifier is on, use of the LOCATE button is inconvenient because of the horizontal repositioning required.

Integrated Fast Displays

The INTEGRATE pushbutton switch permits storage of fast repetitive sweeps that approach or exceed the normal writing speed of the instrument.

1. Set up the calibrator display as in "First-Time Operation", then reset the following controls:

Volts/Div	.2
Time-base Level	Free Run
Time/Div	1 μsec

2. Trigger the display on the rising portion of the calibrator square wave. This will require increasing the display intensity to view the trace.

3. Focus the trace.

4. Press the DISPLAY switches to ERASE and release them. Note that the trace will not store.

5. Adjust the INTENSITY control for a barely visible trace and readjust the focus if necessary.

6. Press the DISPLAY switches to ERASE and release them.

7. Press the INTEGRATE button and hold it in for about 5 seconds.

8. Release the INTEGRATE button. A stored trace should be present on the screen (see Fig. 2-5). If not, repeat the demonstration and hold the INTEGRATE button for a few seconds longer.

9. At the end of the demonstration, turn the INTENSITY control fully counterclockwise and set the DISPLAY switches to NON STORE.

NOTE

When using the INTEGRATE button, if the signal has time-jitter, portions of the stored display may blur or thicken, since the sweeps do not repeat at exactly the same position on the screen.

Fast-Rise Waveforms

The INTEGRATE button, when used in conjunction with the INTENSITY control as described in this demonstration,

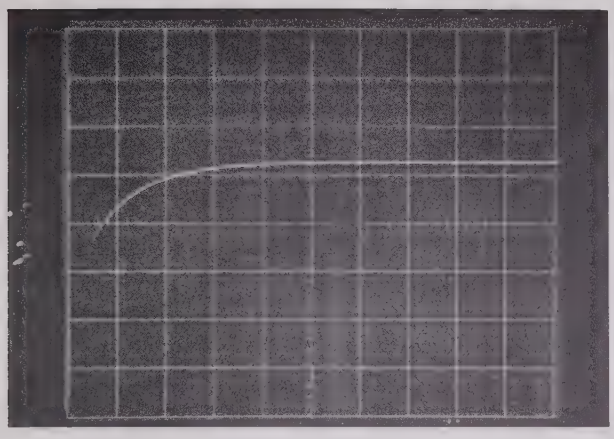


Fig. 2-5. Stored display of calibrator rise using the INTEGRATE button, at 1 μsec/div sweep rate.

permits storage of relatively fast-rising and fast-falling portions of a waveform. This method may also be used for producing a high-resolution display of any waveform.

1. Connect a 25-kc square-wave signal ($T_r \approx 20$ nsec) to the amplifier unit input.

2. Set the controls as given in "First-Time Operation", except for the following:

Volts/Div	10
Time/Div	20 μsec (5 μsec for T5640-201 crt)

3. Adjust the INTENSITY control for normal brightness of the free-running trace.

4. Adjust the square-wave amplitude and the amplifier unit Volts/Div switch to produce about 3 major divisions of vertical deflection on the crt screen.

5. Trigger the square-wave display and adjust the focus.

6. Set the DISPLAY switches to STORE and attempt to store the waveform by the previous methods. Do not, however, violate the precautions given previously under "Care of Storage Screens." Note that even though the vertical portions of the waveform are visible when the writing beam is displayed, they cannot be stored well with the methods described previously.

7. Turn the INTENSITY control fully counterclockwise.

8. Press the DISPLAY switches to ERASE and release them.

9. Press the INTEGRATE button and hold it in.

10. Advance the INTENSITY control until the vertical portions of the trace are just barely visible (using the viewing hood).

11. Hold the INTEGRATE button in for about 20 seconds, then turn the INTENSITY control to minimum while the INTEGRATE button is still pressed.

12. Release the INTEGRATE button. Both the horizontal and vertical segments of the display should now be stored (see Fig. 2-6).

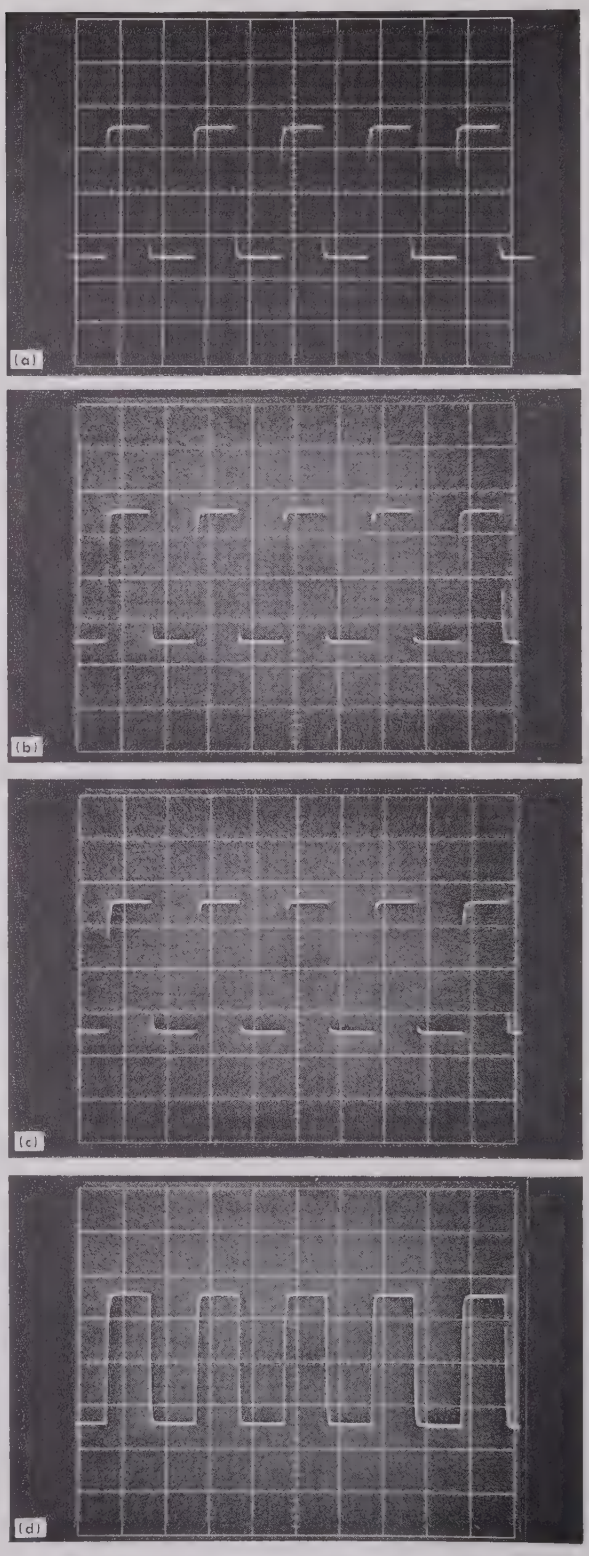


Fig. 2-6. Storage of fast-rise waveform showing difference in storage techniques: (a) non-store display; (b) stored with INTENSITY control alone; (c) stored with INTEGRATE button; (d) stored with INTEGRATE button and INTENSITY control as described in text.

13. Repeat this demonstration several times using slightly different intensity levels and integrating for different lengths of time. Best resolution is generally produced by using very low intensity and integrating for a long period (many seconds).

CAUTION

Do not attempt to store extremely fast-rising or fast-falling portions of waveforms viewed at relatively slow sweep rates. The high trace intensity required (due to the intensity difference between the horizontal and vertical segments) would cause storage-target damage.

14. At the end of the demonstration, turn the INTENSITY control fully counterclockwise and set the DISPLAY switches to NON STORE.

Single-Sweep Storage

Slow and Medium Sweep Rates

This method of storage is used for single-sweep displays that produce crt traces of adequate intensity.

1. Set up a normal-intensity non-store calibrator display as in "First-Time Operation".

2. Set the time-base Mode switch to Single Sweep.

3. Press the DISPLAY switches to ERASE and release them.

4. Apply a single sweep of the trace. A stored display of the calibrator waveform should remain on the storage screens. If not, repeat the demonstration with the display intensity increased slightly.

5. At the end of the demonstration, reset the following controls:

INTENSITY	Counterclockwise
DISPLAY (both)	NON STORE
Time-base Mode	Normal

Single-Sweep Trace Location

The LOCATE button permits trace positioning while the sweep is held off. In single-sweep mode, due to the increased writing-beam intensity required at medium and fast sweep rates, the intensity must be turned down before the LOCATE button is pressed. Flaring will occur at the left edge of the stored display if the intensity is not decreased.

1. Connect a 10-kc square-wave or sine-wave signal to the amplifier unit input.

2. Set the controls as given in "First-Time Operation", except for the following:

Volts/Div	10
Time/Div	50 μsec

3. Adjust the INTENSITY control for normal brightness of the free-running trace.

4. Adjust the signal amplitude and the amplifier unit Volts/Div switch to produce approximately 2 cm of deflection on the crt screen.

5. Trigger the display.

6. Position the display entirely on the upper storage screen.

7. Set the time-base Mode switch to Single Sweep.

8. Apply several single sweeps of the trace while adjusting the INTENSITY and FOCUS controls for a well-defined single-sweep display.

9. Press the Upper DISPLAY switch to ERASE and release it.

10. Apply a single sweep of the trace to store the display.

11. Turn down the intensity to the approximate level required for a repetitive sweep.

12. Press the LOCATE button and hold it in. If the line or set of dots at the left edge of the screen is not at normal intensity, readjust the INTENSITY control slightly.

13. While pressing the LOCATE button, position the display to the lower storage screen.

14. Release the LOCATE button.

15. Apply several single sweeps and readjust the INTENSITY control to the single-sweep level.

16. Press the Lower DISPLAY switch to ERASE and release it.

17. Apply a single sweep of the trace to store a display on the lower screen. Both screens should now have stored single-sweep displays.

18. At the end of the demonstration, reset the following controls:

INTENSITY	Counterclockwise
DISPLAY (both)	NON STORE
Time-base Mode	Normal

Fast Sweep Enhancement

The WRITING RATE INCREASE control provides a method of storing single-event displays that exceed the normal writing speed of the instrument. This mode is not normally used for repetitive sweeps.

1. Apply a 25-kc square-wave signal ($T_r \approx 20$ nsec) to the amplifier unit input.

2. Set the controls as given in "First-Time Operation", except for the following:

Volts/Div	10
Time/Div	10 μsec (2 μsec for T5640-201 crt)

3. Adjust the INTENSITY control to observe the trace.

4. Set the square-wave amplitude and the amplifier unit Volts/Div switch to display about 3 major divisions of deflection.

5. Trigger the display.

6. Set the time-base Mode switch to Single Sweep.

7. Apply several single sweeps of the trace while adjusting the INTENSITY and FOCUS controls for a well-defined display.

CAUTION

Do not allow the time-base Mode switch to be set to Normal while the intensity is set at a high level.

8. Press the DISPLAY switches to ERASE, then release them.

9. Apply a single sweep of the trace. Note that the trace will not store.

10. Pull out the WRITING RATE INCREASE control and turn it to about midrange.

11. Apply a single sweep of the trace. The display should now store.

12. Erase the screens and repeat the demonstration several times using different settings of the WRITING RATE INCREASE control. After a trace is stored, turn off (push in) the WRITING RATE INCREASE control to avoid accidental operation of the enhancement circuit.

NOTE

Whenever the WRITING RATE INCREASE control is used, it affects both the upper and lower storage screens. In this mode of operation, because of background positive fading, it is not normally possible to produce a stored display of more than about 1 or 2 traces.

13. At the end of the demonstration, reset the following controls:

INTENSITY	Counterclockwise
WRITING RATE INCREASE	Off (pushed in)
DISPLAY (both)	NON STORE
Time-base Mode	Normal

Remote-Erase Operation

Either erase circuit can be operated remotely by grounding the appropriate pin of the rear-panel remote-erase jack (J950), or by applying a negative 5- to 10-volt pulse to the pin. Pin A is connected to the upper screen erase circuit and pin B is connected to the lower screen circuit. Pin D is connected to ground for your convenience.

1. Set up the calibrator display as described in "First-Time Operation."

2. Store one calibrator waveform on the upper screen and one on the lower screen using one of the repetitive-sweep storage procedures.

3. Connect a bare wire (approximately 2 inches long by 22 gauge) between chassis ground and pin A of the remote-erase jack. The upper screen should erase as the connection is made, then should return to the ready-to-store condition.

4. Connect the wire between ground and pin B of the jack. The lower screen should erase, then return to the ready condition.

5. Remove the wire.

6. At the end of the demonstration, set the DISPLAY switches to NON STORE.

NOTE

When installing a remote-erase hook up, if you use a shorting switch, be sure it is of the momentary-contact type (normally open). If the input pin remains connected to ground, the front-panel DISPLAY switches will not operate properly.

INTENSITY MODULATION

Intensity (Z-axis) modulation can be used to relate other voltage information to the displayed signal without changing the shape of the waveform. The modulation signal is applied to the crt cathode through the rear-panel EXT CRT CATHODE jack. With the INTENSITY control set correctly, positive pulses between 3 and 50 volts in amplitude will dim or blank the crt beam, and negative pulses between 3 and 50 volts in amplitude will brighten the beam.

Time markers may be applied for direct time reference of the display or for establishing the sweep rate when uncalibrated deflection is used. Fast-rise pulses of short duration provide best resolution with respect to time. If the markers are not time-related to the displayed waveform, a single-sweep display is required. If sine waves are used, the minimum useable frequency is about 250 cps, due to ac-coupling at the input. Be sure to ground the EXT CRT CATHODE jack when it is not in use, to avoid random intensity modulation from stray signals.

Since there is only one intensity level in a stored display, modulation can be stored only by modifying the display in some manner. The stored waveform may be modified by one of the following methods: dimming the modulated portions of the waveform so they do not store; brightening the modulated portions from a dim background so only the modulated portions store; widening the modulated portions by superimposing a defocused modulated display over the normal stored waveform. The following demonstrations illustrate these methods of modulation.

Modulation by Positive Blanking

The best intensity-modulated stored displays are usually produced by applying positive modulation pulses that lower the intensity of the modulated portions below the storage threshold.

1. Connect a 10-μsec time-mark signal to the amplifier input.

2. Unground the EXT CRT CATHODE jack and apply a 30-volt (approx.) 1-μsec positive-going time-mark signal.

3. Set controls as in "First-Time Operation", except for the following:

Volts/Div	2
Time/Div	2 μsec

4. Advance the INTENSITY control to display a dim trace on the crt screen.

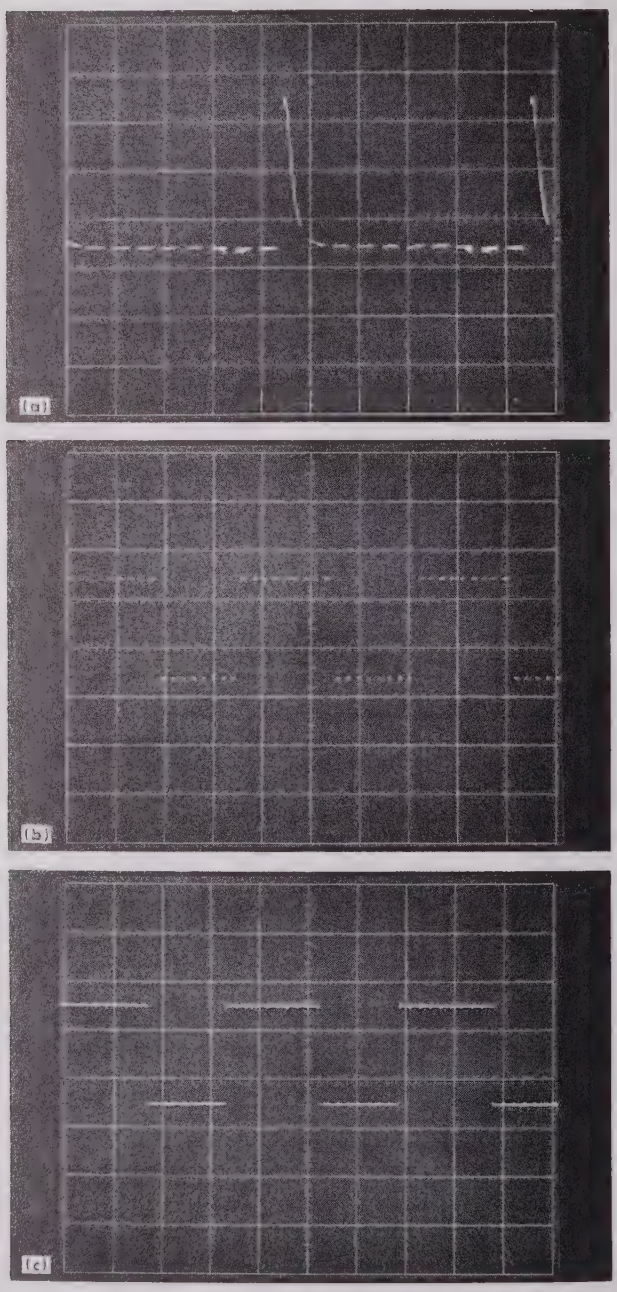


Fig. 2-7. Three modes of intensity modulation for display storage: (a) positive-pulse blanking; (b) negative-pulse intensification; (c) trace widening. Displays are described in text.

5. Trigger the display with the time-base Level control. The display should consist of 10-μsec time markers with blanked portions occurring every 1 μsec.

6. Set the amplifier unit Volts/Div switch and Variable control to produce about 3 major divisions of deflection.

7. Turn the INTENSITY control fully counterclockwise.

8. Press both DISPLAY switches to ERASE, then release them.

9. Use the Fast-Rise Waveform storage procedure described previously to store the modulated display. When the operation is performed correctly, only the unmodulated portions of the display should be stored (see Fig. 2-7a).

10. At the end of the demonstration, turn the INTENSITY control fully counterclockwise and set the DISPLAY switches to NON STORE.

Modulation by Negative Intensification

1. Connect a coaxial cable from the CAL OUT connector to the input connector of the amplifier unit.

2. With the EXT CRT CATHODE jack ungrounded, apply a 30-volt 1-kc negative-going square wave to the jack.

3. Set the controls as in "First-Time Operation."

4. Advance the INTENSITY control to display a dim trace on the crt screen.

5. Trigger the display with the time-base Level control. The display should consist of about 3 cycles of the calibrator waveform made up of 1-kc intensified dots.

6. Set the time-base Mode switch to Single Sweep.

7. Press the DISPLAY switches to ERASE and release them.

8. Store the modulated calibrator waveform using the single-sweep method of storage described previously. (Single sweep must be used for modulation that is not time-related to the input signal.) The stored display should consist of only the display segments that are intensified by modulation (see Fig. 2-7b).

Trace-Width Modulation

Leave the equipment set up as at the end of the preceding demonstration.

1. Note the position of the FOCUS control at the point of best focus, then turn the control approximately 30° counterclockwise from that point.

2. Press the DISPLAY switches to ERASE and release to STORE.

3. Store a single sweep of the modulated calibrator waveform.

4. Reset the following controls (in the order given):

INTENSITY	Counterclockwise
CRT CATHODE SELECTOR	CHOPPED BLANKING
Time-base Mode	Normal

5. Return the FOCUS control to the point of best focus.

6. Advance the INTENSITY control to store a normal-intensity focused trace superimposed on the stored defocused waveform, then return the INTENSITY control to the minimum position. The composite stored waveform should consist of the calibrator waveform with widened portions produced by the 1-kc modulation (see Fig. 2-7c).

7. At the end of the demonstration disconnect the modulation signal and connect the grounding bar to the EXT CRT CATHODE jack. Set the CRT CATHODE SELECTOR switch to EXT CRT CATHODE position.

8. Remove the calibrator signal and set the DISPLAY switches to NON STORE.

DISPLAY PHOTOGRAPHY

A permanent record of the crt display may be obtained through the use of a trace-recording camera. When the Type RM564 Oscilloscope is operated in non-store mode, trace photography is accomplished in essentially the same manner as with a conventional oscilloscope. Use normal trace intensity and set the graticule illumination so that it is approximately two-thirds as bright as the trace. See the instructions accompanying the camera for specific techniques.

When the oscilloscope is operated in storage mode, the display may be stored and erased as many times as is necessary to obtain the desired display charateristics before a picture is taken. For non-repetitive waveforms and certain other applications, the ability to compose the display in advance permits the saving of a considerable quantity of film.

Due to the presence of a background glow on the storage screens, special care must be taken in the exposure times and f-stop settings that are used. These will depend on the type of film used. The graticule illumination should be set to a level slightly less bright than the stored waveform. The trace-to-background contrast in the developed picture can usually be improved by allowing the film to overdevelop slightly.

Most of the pictures of storage-mode displays shown in this manual were taken on ASA3000 medium-contrast film at about 1/10 second and f 5.6. Greater contrast can be obtained with a high-contrast type of film.

NOTES

SECTION 3

CIRCUIT DESCRIPTION

General Information

The ability of the Type RM564 to store crt displays, in addition to presenting them conventionally, is provided through the addition of certain storage elements in the crt and special circuitry to operate those elements. The remainder of the instrument consists of a regulated low-voltage supply circuit, a crt writing-gun circuit, a calibrator circuit and receptacles for two plug-in units. The block diagram with the schematic diagrams at the rear of this manual shows the functional relationships between the various circuits.

LOW-VOLTAGE SUPPLIES

Transformer T601 has two primary windings which are connected in parallel for 117-volt operation or in series for 234-volt operation. T601 has several secondary windings to supply ac and dc voltages for the oscilloscope and plug-in units.

Regulated Dc Voltages

There are four regulated voltages: —12.2, —100, +125 and +300 volts. Each of these supplies uses silicon diode rectifiers followed by a series regulator circuit.

The —100-, +125- and +300-volt supplies are designed to operate over a wide range of current requirements so that different plug-in units may be used. The amount of current available from each supply is determined by the total shunt resistance across each series regulator tube. If a plug-in unit requires a large amount of current, the unit is designed with a shunt resistor or shorting strap that connects around the series regulator tube when the unit is plugged into the oscilloscope. The shunt in the plug-in unit is then connected in series with a 2-kilohm resistor (½ of a 4-kilohm resistor) in the power supply.

—100-Volt Supply

Reference voltage for the —100-volt supply is established by gas diode V609. The constant voltage drop across V609 establishes a fixed voltage of about —80 volts at the grid of V634B. Voltage at the grid of V634A is established by divider R616, R617 and R618. The voltage difference between the two grids of V634 sets the plate current of V634A. Plate current of V634A determines the base voltage of transistor Q624 which, in turn, determines the grid voltage of series tube V627. The series tube plate resistance changes to hold the load voltage constant. R616 (—100 VOLTS) determines the percentage of the total divider voltage applied to the grid of V634A and thus controls the output voltage. When this control is properly adjusted, the output is exactly —100 volts.

If the output voltage tends to change because of a change in input voltage or a change in load current, the voltage at the grid of V634A will change a proportional amount. Any change at this grid is amplified by V634A and Q624 and applied to the grid of V627. The resulting grid change of V627 will cause its plate resistance to change in the direction that will bring the output back to —100 volts. C616 improves the response of the regulator to sudden changes in output voltage.

R629 shunts the series regulator tube to provide sufficient current for both the indicator unit and the plug-in units. R628 is part of the series-tube shunt connected by those plug-in units that require considerable current.

+125-Volt Supply

The —100-volt supply serves as a reference for the +125-volt supply. With the R651 end of divider R650-R651 fixed at —100 volts, any change in the +125-volt output produces a proportional change at the grid of V654. This change is amplified and applied to the grid of series regulator V667A. The change at the grid of V667A changes its plate resistance to bring the output voltage back to +125 volts. R656 (+125 VOLTS) sets the percentage of total divider voltage applied to the grid of V654 and permits adjustment of the output voltage. When this control is properly adjusted, the output is exactly +125 volts. C650 improves the response of the regulator to sudden changes in output voltages. R666 is part of the series-tube shunt.

+300-Volt Supply

Operation of the +300-volt supply circuit is essentially the same as that of the +125-volt supply, with the —100-volt supply serving as a reference. To provide the voltage for the +300-volt regulator, rectified voltage from terminals 19 and 20 of transformer T601 is added to the voltage supplying the +125-volt regulator. R676 (+300 VOLTS) adjusts the output voltage.

The +300-volt supply also provides an unregulated +420 volts for the crt high-voltage oscillator circuit.

B903 and R903 (shown on the storage circuit diagram) between the +300-volt supply and the +475-volt unregulated supply, provide a +355-volt source for use by the storage level network, the erase multivibrators and the LOCATE switch. The +355 volts, developed by the constant drop of 55 volts across B903, is regulated by the +300-volt supply.

—12.2-Volt Supply

Operation of the —12.2-volt regulating circuit is essentially the same as that of the other regulating circuits, except that transistors are used instead of vacuum tubes. The base of Q734 is fixed near —12 volts by voltage divider R731 and R732 between —100 volts and ground. Any variation of the —12.2-volt output at the emitter of Q734 is amplified by Q734 and Q744 to change the collector resistance of Q757 which is in series with the load. R730 (—12.2 VOLTS) adjusts the voltage applied to the base of Q734. When this control is properly adjusted, the output is exactly —12.2 volts. F720 protects Q757 in case of an overload on the —12.2-volt supply.

+475-Volt Supply (Unregulated)

The half-wave rectified voltage from terminals 21 and 22 of T601 is added to the +300-volt supply producing a +475-volt storage circuit supply. C646 filters the voltage rectified by D646.

CALIBRATOR

The calibrator circuit in the Type RM564 produces line-frequency amplitude-calibrated square waves.

The 6.3-volt ac (about 18 volts peak-to-peak) heater waveform is coupled from T601 through C876 to the cathode of V884A. The amplified signal at the plate of V884A is coupled to the grid of V884B to turn that tube on and off. Regenerative feedback from the plate of V884B to the grid of V884A speeds up the switching action and drives V884A into and out of cutoff.

The voltage present at the cathode of V884B during the time V884B is conducting is adjusted with R871 (CAL AMPL) to exactly +100 volts. The voltage divider in the cathode circuit of V884B contains precision resistors to provide an output accuracy of 3% or better at the various settings of the CALIBRATOR switch, with high impedance connected to the output.

When the CALIBRATOR switch is set to the 1V position and the CAL OUT connector is terminated in 50 ohms, the output amplitude is 0.1 volt.

DEFLECTION CIRCUITS

Push-pull horizontal and vertical signals for deflecting the writing-gun beam are received through pins 17 and 21 of each plug-in unit and applied to the respective deflection plates of the crt. The effective deflection circuit capacitance encountered by each of these signals at the plug-in connector affects the bandpass and phase shift of the plug-in unit. Compensating capacitors C760 and C761 (shown on the Interconnecting Sockets diagram) are factory-adjusted to set the effective capacitance at a standard value of 14.3 picofarads.

CRT (WRITING-GUN) CIRCUIT

The crt circuit contains the cathode-ray tube writing-gun high-voltage supply and the writing-gun control circuits.

Writing-Gun High Voltage

The accelerating potential applied to the writing-gun beam is approximately 3500 volts, developed by the —3300 volts at the writing-gun cathode and the +200 volts average potential at the deflection and flood-gun structure. With this accelerating potential the nominal vertical and horizontal deflection factor are approximately 19.5 and 18.5 volts per centimeter respectively .

A Hartley oscillator, consisting of V800, the primary of T801 and the capacitance of the circuit, provides energy for the high-voltage rectifiers through T801. The oscillator circuit operates at a frequency of about 45 kc.

The output of one secondary winding of T801 is rectified by V822, providing negative voltage for the writing-gun cathode and the focus anode. This voltage is —3300 volts at the cathode and ranges from approximately —2000 to —3000 volts at the focusing element, depending on the setting of the FOCUS control (R844). The 6.3-volt writing-gun heater is also elevated to the cathode potential through R851.

The output of the other secondary winding of T801 is rectified by V832 for the writing-gun control grid. The grid voltage ranges from about —3300 volts to about —3450 volts, depending on the INTENSITY control setting and any intensification signals received from the time-base plug-in unit (delayed sweep only). Reference to ground for this supply is set by the voltage at the junction of diodes D838 and D839. Thus, the voltage at this junction and the setting of the INTENSITY control determine the intensity of the writing-gun beam.

Neon bulbs B856 and B857 limit the writing-gun grid-to-cathode voltage to less than 200 volts for protection of the crt electrodes. Normally the neon bulbs are not conducting. If the potential difference between the grid and cathode reaches 200 volts, the neons begin to conduct, then hold a constant 120-volt drop until the electrode voltages return to normal.

Regulation of the —3300-volt supply is accomplished by feedback through R841 (HIGH VOLTAGE). If the output of the —3300-volt supply begins to change slightly, a proportional change is applied through R841 to the grid of V814B where it is referenced to the —100-volt supply at the cathode. The change is amplified by V814 and coupled to the screen of V800 where it decreases or increases the amplitude of oscillations through V800, thus changing the output of T801 in the direction that will return the high voltage to the correct level. R841 is adjusted to set the bias of V814B for the correct high-voltage output.

Writing-Beam (CRT) Controls

INTENSITY control R833 adjusts the intensity of the display by varying the writing-gun bias over a range of 0 to —150 volts, relative to the cathode voltage.

FOCUS control R844 and ASTIG control R864 are operated in conjunction with each other to adjust the writing-beam focus. The FOCUS control varies the focusing anode voltage over the range from —2000 to —3000 volts. The ASTIG control adjusts the astigmatism anode voltage over the range from 0 to +300 volts.

TRACE ALIGNMENT control R860 adjusts the dc current through beam-rotation coil L860 to align the display with the crt graticule.

LOCATE button SW868 locates the vertical position of the display (with the sweep held off) by unblanking the writing beam while deflecting the beam to the non-storage strip at the left edge of the storage screens. A positive voltage applied to the left horizontal deflection plate deflects the beam.

Blanking

The writing-gun beam in the Type RM564 is blanked by a special set of deflection plates in the crt. One on the plates (pin 7) is connected directly to the +125-volt supply through R868, R867 and switch SW868 (LOCATE pushbutton). The

second plate (pin 5) is connected through the Type RM564 to the horizontal plug-in unit. When there is no sweep, the quiescent voltage applied by the horizontal unit produces sufficient potential difference between the two blanking plates to deflect the writing-gun beam into the deflection structure so that it does not reach the crt screen.

Whenever the two blanking-plate voltages become equal, the beam is allowed to pass through to the crt screen. This occurs under the following conditions: whenever a sweep is produced; when the LOCATE button is pressed, or when the horizontal plug-in unit is removed.

Unblanking during the sweep is produced by a +125-volt gate pulse applied to pin 5, equaling the +125 volts normally present at pin 7. Unblanking that occurs when the LOCATE button is pressed is accomplished by disconnecting pin 7 from the +125-volt supply. The voltage applied through R869 then equalizes the two blanking plates at the voltage received from the horizontal plug-in unit. (At the same time, the LOCATE button causes the beam to be deflected to the left edge of the screen by connecting the left horizontal deflection plate to +355 volts.) When the horizontal plug-in unit is removed from the Type RM564, the beam is unblanked as the deflection voltage source from the plug-in unit is disconnected from pin 5. In this case, the voltage applied through R869 equalizes the two blanking plates at +125 volts.

Intensity Modulation

The intensity of the writing-beam display may be modulated by applying signals to either the grid or the cathode of the writing gun.

Intensifying signals from a delayed sweep time-base plug-in unit are applied to the grid supply through pin 14 of the horizontal plug-in inteconnecting socket. When the overall display intensity is reduced by the time-base unit (set to Intensified), positive intensifying pulses brighten the delayed-sweep portion of the delaying-sweep display. During the time that the beam is not brightened, the writing-gun grid-supply return path is through D839 to a negative voltage in the intensifying circuit of the plug-in unit. At this time, D838 is reverse biased by the negative voltage at the junction of the two diodes. Intensification results when the positive pulse from the time-base unit turns D839 off and the grid-supply return path is through D838 (as for normal sweep operation). R837 and C837 then couple the intensifying pulse directly to the crt grid. Thus the brightened portion of the delaying sweep display is the same intensity as a normal display and the background trace is dimmed.

External modulating signals may be applied to the writing-gun by way of the cathode, through the rear-panel EXT CRT CATHODE jack. With the INTENSITY control adjusted properly, a positive or negative pulse between 3 and 50 volts in amplitude will produce dimming or intensification of the writing beam.

STORAGE CIRUIT

The storge circuit is made up of the storage portions of the crt, two operating-level cathode followers, two erase multivibrators, a trace enhancement circuit, an INTEGRATE switch and several dividers that set the storage electrode voltages.

Storage Tube

The storage cathode-ray tube contains certain special storage elements in addition to the conventional writing-gun elements. The operating mode of the tube depends primarily on the voltages applied to the storage elements. With one set of voltages applied, the storage screen operates in the storage mode and is able to store waveform displays. With a different set of voltages applied, the screen operates in non-store mode and presents a display similar to that of a conventional oscilloscope.

The storage elements of the crt consist essentially of the flood guns, the collimation electrodes and the storage screens. The flood guns are a high-current source of low-velocity electrons that flood the storage screens, producing a slight background illumination whenever the instrument is operated in storage mode. The collimation electrodes direct and shape the flood-gun electron beams so they are distributed evenly over the screens. The storage screens are specially-constructed surfaces that are able to continue displaying light information after being bombarded by the writing-gun beam while activated by the flood-gun electrons. The two screens are electrically isolated and can be operated independently of each other, either in storage or non-store mode.

Operating Level CFs

Constant voltage sources for the upper and lower storage-target backplates are provided by operating-level cathode followers V913A and V913B. The voltage that is applied to each backplate depends on the position of the corresponding DISPLAY switch (SW910 or SW911) in the grid circuit of the cathode follower. When the DISPLAY switch is set to NON STORE, a voltage of approximately +120 volts is applied from R906 (NON STORAGE LEVEL) through the corresponding cathode follower to the backplate of the screen. At this voltage level, storage of the writing-gun display will not occur.

When the DISPLAY switch is set to STORE, approximately +225 volts is applied from R904 (STORAGE LEVEL) through the cathode follower to the storage-target backplate (see Fig. 3-1). Sufficient flood-gun current is drawn to raise the phosphor energy level to a point slightly below the secondary-electron emission threshold. Any of the phosphors that are then raised above the secondary-emission threshold by additional energy received from the writing-gun beam are held in a high-energy state by the flood-gun current and continue to emit light. The phosphors that continue to glow after the writing beam has passed produce the stored image on the screen.

As each screen becomes increasingly written (stored), its backplate current increases slightly, but the backplate voltage is held constant by the operating-level cathode follower.

When the DISPLAY switch is pressed to ERASE, a large positive voltage pulse (approximately +250 volts) is applied from the erase multivibrator through C916 (or C918) and the cathode follower to the backplate. The erase pulse first raises all the phosphors above the secondary-emission threshold, then drives the energy level of the entire screen below the secondary-emission level. This erases the stored image and returns the screen to its "ready" condition, able to store the next image produced by the writing beam.

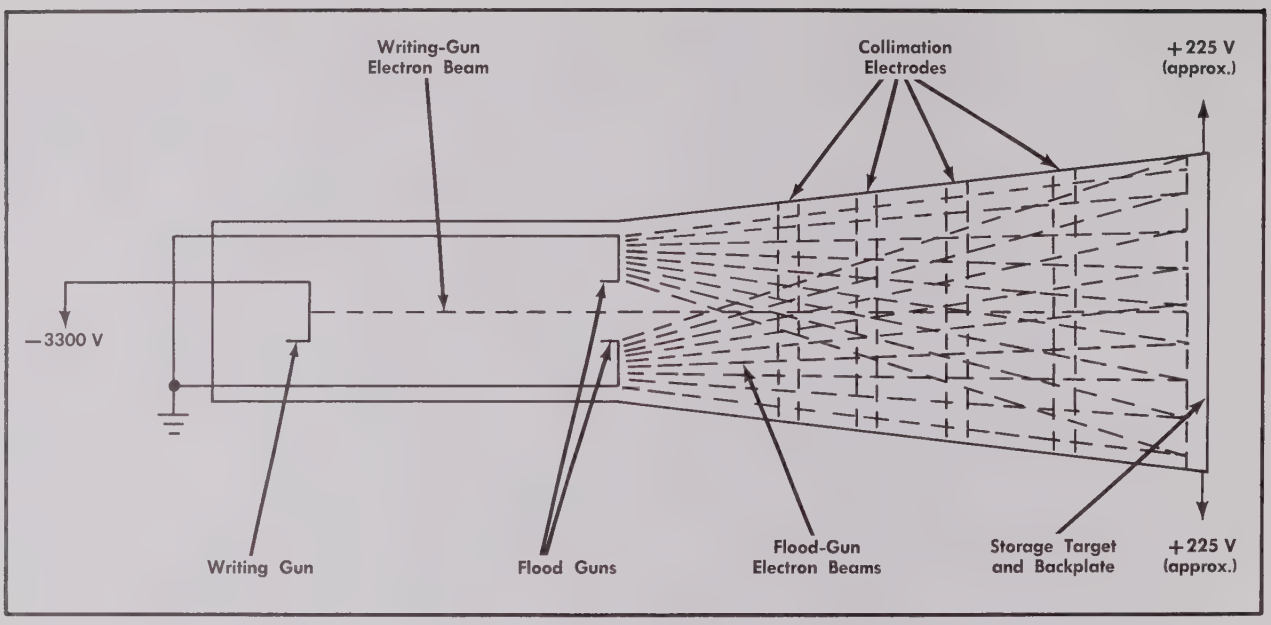


Fig. 3-1. Simplified cathode-ray storage tube operation in storage mode. Deflection and control elements are not shown. (In the non-store mode, storage target voltage is approximately +120 volts.)

Collimation Electrodes

The voltages applied to the collimation electrodes are adjusted by R930 (COVERAGE 1) and R938 (COVERAGE 2). The voltage applied to the flood-gun anode and the first two collimation grids is adjusted to approximately +180 volts by R940 (GEOMETRY). This control also sets the voltage on the deflection-plate isolation shield.

Erase Multivibrators

Two monostable multivibrators, V955 and V965, provide erase pulses that remove stored images from the two screens and prepare the screens for subsequent storage operation. Each of these circuits is actuated either by operating the corresponding DISPLAY switch or by grounding the appropriate pin of the rear-panel remote erase jack (J950). Since the operation of the two circuits is identical, the following description of the upper screen erase circuit (except for circuit numbers) applies to the operation of the lower screen circuit.

Quiescently V955A is conducting moderately and V955B is conducting slightly. With the Upper DISPLAY switch (SW910) set to STORE, the junction between R950 and R951 is held at about +9 volts and the grid of V955A is at zero volts. When the junction of R950-R951 is grounded, either by pressing the DISPLAY switch to ERASE (or NON STORE) or by grounding pin A of the remote-erase jack, a 9-volt negative-going pulse is applied through C952 to the grid of V955A. As V955A cuts off, the positive pulse at its plate turns V955B on hard, producing a large positive output pulse (about 350 volts) at the cathode of V955B. Regenerative feedback through C958 to the cathode of V955A holds V955A in cutoff momentarily. As soon as C958 has had time to discharge (about 50 msec), V955A again conducts reverting the multivibrator which then produces the falling edge of the erase pulse.

The output pulse is partially differentiated by C916 and applied through V913A to the upper storage screen. The positive-going portion of the pulse raises the screen voltage above the secondary-emission threshold, the approximately 50 msec later the negative-going portion of the pulse drives the screen voltage well below the secondary-emission threshold, erasing any stored image. Within 250 msec of the start of the erase pulse, the screen is again capable of storage.

A portion of the erase pulse is also applied through D933, C932 and a voltage divider to collimation electrodes 6 and 7 to keep the flood-gun electrons uniformly distributed over the screen while it is being erased.

Integrate Switch

When the INTEGRATE pushbutton switch (SW948) is in its normal position, the flood guns are held at ground level by the path through L948, SW948 nd D948. With the DISPLAY switch at STORE, pressing the INTEGRATE button disconnects the flood guns from ground and cuts off the flood-gun current. As current cuts off, the cathode voltage rises to about +55 volts due to continued electron emission. The flood-gun background illumination of the screens ceases, though the storage-target backplate voltage is still at the storage operating level. If the writing gun is displaying a repetitive waveform on the storage screen at this time, its beam is allowed to trace several times over the same phosphors. When the INTEGRATE button is then released, the flood-gun current is restored and any phosphors that have been raised above the secondary-emission threshold by the writing-gun beam (during flood-gun cutoff) emit light at the normal stored light level.

When the INTEGRATE button is pressed, it also connects the high-voltage divider to ground through R948 and R848 (in the crt circuit), adjusting the high-voltage supply slightly to

correct for the deflection change that occurs when the flood guns are turned off.

R944 (B FLOOD GUN BIAS) and R946 (A FLOOD GUN BIAS) are adjusted to set the flood-gun grid voltages at approximately —50 volts for maximum uniform flooding of the storage screens.

Trace-Enhancement Circuit

Q975 and Q985 form a monstable multivibrator that is operated by the time-base unit dual-trace sync pulse when the WRITING RATE INCREASE switch (SW977) is turned on. The negative-going sync pulse is applied through pin 4 of the horizontal interconnecting jack, then through R970, C970 and D972 to the base of Q975. In single-sweep mode, a single pulse is applied at the start of each sweep. (The trace-enhancement circuit is not ordinarily used for repetitive sweeps.) The negative pulse turns on D972 which is normally reverse biased due to current through the base-emitter junction of Q975, D973* and the WRITING RATE INCREASE control.

If the WRITING RATE INCREASE switch is off when the negative pulse is received, the circuit is not affected, since the collector circuit of Q975 is open. If the WRITING RATE INCREASE switch is turned on and either DISPLAY switch is at STORE, the collector of Q975 is connected to ground and the transistor is conducting. Q985 which is normally not conducting remains off until an input pulse is received by Q975.

A negative pulse applied to the base of Q975 cuts off that transistor, turning on Q985. The large negative output pulse produced at the collector of Q985 is applied to the pulse amplitude network, R983 through R985. Regenerative feedback to the base of Q975 through C985, R979 and D973* prolongs the output pulse for a duration determined primarily by the time constant of C985 and the circuit resistance to ground. This time constant, and thus the enhancement pulse width, is adjusted by R977 (WRITING RATE INCREASE). As soon as C985 has discharged, Q975 turns on again, Q985 cuts off and the circuit returns to a "ready" condition to be activated by the next sync pulse.

The amplitude of the enhancement pulse to be applied to the flood guns is adjusted by R984 (PULSE AMPL). The resultant pulse of from —30 to —80 volts at the center arm of R984 is applied to the flood-gun cathodes through SW948 and L948, and to the flood-gun grids through C945 and C947. By increasing the accelerating potential of the flood guns during a single sweep of the trace, the negative pulse from the trace-enhancement circuit increases the energy of the flood-gun electrons for the duration of the enhancement pulse. Thus while the flood guns hold the phosphors very close to the secondary-emission threshold, less energy is required from the writing-beam electrons and the effective writing speed is increased, allowing very fast single sweeps to be stored.

* S/N 360-up.

NOTES

SECTION 4

MAINTENANCE

PREVENTIVE MAINTENANCE

The Type RM564 Oscilloscope is a precision instrument and therefore requires and deserves adequate care. If the instrument is serviced and recalibrated at regular intervals it will provide a long life of reliable and accurate service.

Periodic Inspection and Recalibration

The Type RM564 should be serviced and recalibrated after each 500 hours of operation or more frequently if operated under adverse conditions such as a dusty atmosphere or high temperature. Even if the instrument is used only occasionally, it should be serviced and recalibrated at least once every 6 months. Servicing and troubleshooting suggestions are given in this section of the manual. See the Calibration section for calibration procedures.

Whenever the instrument is repaired or recalibrated, a visual check should be made of the controls and circuitry. Certain types of trouble can be detected by a visual inspection. Look for such obvious defects at control knobs out of alignment, damaged connectors, loose or broken solder connections, improperly seated tubes or transistors, broken terminal strips and scorched parts. Most of these troubles can be corrected by obvious means. In the case of heat-damaged parts, however, the damage is often the result of less apparent trouble. In order to prevent further damage, the cause of the overheating should be located and corrected before attempting to operate the instrument.

We advise against routine replacement of electron tubes or transistors during periodic servicing. Since each tube or transistor has its own individual operating characteristics, any circuit that has one of these components replaced or exchanged will require a calibration check. If tubes or transistors are to be removed temporarily during servicing, they should be marked with their circuit numbers to be sure they will be returned to their original sockets. Each circuit number is marked on the chassis next to the socket.

Panel Removal

The top and bottom panels of the Type RM564 Oscilloscope can be easily removed for access to the internal circuitry. The panels are fastened to the chassis with Phillips head screws. For normal operation, the panels should be left on the instrument to keep dust out and to distribute the flow of air.

Exterior Cleaning

Dirt can be removed from the front panel and chassis exterior with a soft cloth dampened with a water solution of soap or detergent. Abrasive cleaners should not be used. A dry paint brush may be useful for removing dust from front-panel control knobs.

The glass face of the crt and the plastic graticule can be cleaned with a water solution of soap or detergent or with a simple non-denatured alcohol such as isopropanol.

CAUTION

Do not clean any plastic materials with organic chemical solvents such as benzene, acetone or denatured alcohol. These solvents might damage the plastics.

Interior Cleaning

The interior of the instrument may accumulate a small amount of dust from air that passes through it. To avoid building up a heavy accumulation, this dust should be blown out with a low-velocity stream of compressed air during periodic servicing. (Avoid the use of a high-velocity air stream that might damage small components.) Persistent dirt can be removed with a damp cloth or small paint brush. A cotton-tipped applicator dampened with isopropanol can be used for cleaning narrow spaces and ceramic strips.

Fan Oiling

During periodic servicing, the fan motor should be oiled with a few drops of light machine oil. The recommended oil is Anderol L826, available from the Lehigh Company or Rotron distributors. An industrial hypodermic syringe and needle is used to insert the oil through a protective rubber

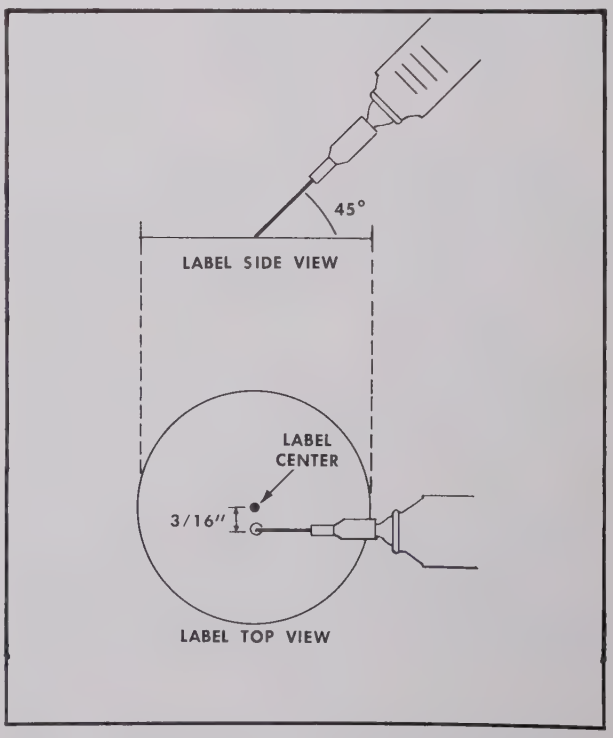


Fig. 4-1. Oiling the fan motor with a hypodermic.

seal. If a syringe and needle cannot be obtained locally, order them through your Tektronix Field Office. Tektronix part numbers are 003-282 for the hypodermic syringe, and 003-285 for the hypodermic needle.

To oil the fan, place the needle as shown in Fig. 4-1. With the needle at a 45° angle, pierce the rubber seal and insert the needle about ¼ inch, then press the syringe plunger to inject a few drops of oil.

CORRECTIVE MAINTENANCE

If apparent trouble develops in the Type RM564 Oscilloscope, first check the settings of all front-panel controls to make sure the instrument malfunction is not the result of some control misadjustment. Review the Operating Instructions if you are not completely familiar with the operation of the instrument. If an external signal is being applied, check the input cable or probe to be sure the signal is reaching the vertical input.

If all front-panel control settings and input connections are found to be correct for the desired mode of operation but the instrument does not operate properly, either there is trouble in the circuitry, or else some part of the system is out of calibration. Check the calibration of any suspected circuit before attempting to troubleshoot the instrument. A complete calibration procedure is given in the Calibration section of this manual. Troubleshooting procedures and suggestions are given later in this section.

Ordering Replacement Parts

If you have established through operational or troubleshooting checks that an electrical or mechanical part requires replacement, the following information may aid you in ordering and replacing the part.

Replacements for all parts used in the Type RM564 can be purchased directly through Tektronix. Many of the electrical parts can also be obtained from local electronics suppliers. Certain critical electrical parts and nearly all mechanical parts normally are not available from other sources and should be ordered from Tektronix. Consult the Parts List in this manual for the required characteristics before ordering or purchasing any part.

When ordering through your local Tektronix Field Office, be sure to include the following information:

1. The complete description of the part as given in the Parts List.

2. The instrument type (Type RM564).

3. The instrument Serial Number.

If a part that is ordered has been superseded by a newer part, the new part will normally be shipped instead of the part ordered.

Replacement Procedures

In general, the replacement of most parts in the Type RM564 Oscilloscope is simple and straightforward—just remove the defective part and install the replacement. Certain parts, however, require special care or special procedures during replacement. The following subsections contain supplementary information and some practical hints that may aid you when performing corrective maintenance on the instrument.

Be sure to install replacement components in exactly the same positions occupied by the original parts. The presence of normal stray fields and capacitance within the instrument makes the positioning of some components important to the operation of the system.

Ceramic Strip Soldering

Many of the components in your Tektronix instruments are mounted on ceramic terminal strips. The notches in these strips are lined with a silver alloy. Application of excessive heat or repeated use of ordinary 60-40 tin-lead solder will break the silver-to-ceramic bond. Occasional use of ordinary solder is permissible, but for general repair work on Tektronix instruments solder containing about 3% silver should be used. Silver-bearing solder is available locally from electronics distributors or may be purchased in 1-pound rolls through your Tektronix Field Office. Order by Tektronix part number 251-514.

When removing or installing a part mounted on ceramic terminal strips:

1. Use a 50-watt to 75-watt soldering iron with a thin wedge-shaped tip.

2. Tin the tip of the iron with silver-bearing solder.

3. Apply heat by touching one corner of the soldering iron tip to the base of the notch. See Fig. 4-2. Do not force the tip of the iron into the terminal notch, as this may chip or break the ceramic strip.

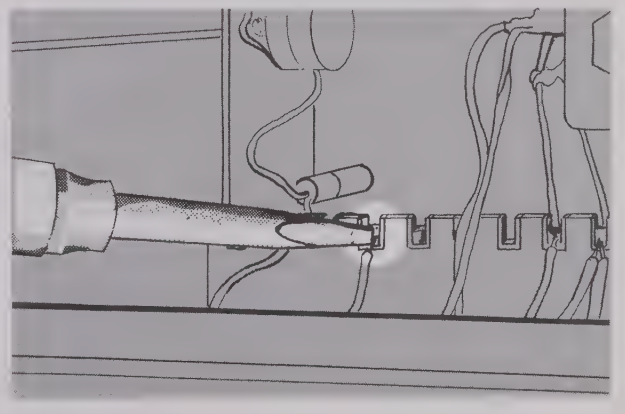


Fig. 4-2. Correct method of applying heat when soldering on a ceramic terminal strip.

4. Use the minimum amount of heat required to make the solder flow freely.

5. Apply only enough solder to form a good bond. Do not attempt to fill the notch with solder.

Other Soldering Considerations

When soldering to a rotary switch, do not let the solder flow around and beyond the rivet on the switch terminal. The spring tension of the switch contact may be destroyed by excess solder and the switch will need to be replaced.

When soldering or unsoldering any short-lead or small component, observe the following precautions:

1. Use long-nosed pliers to act as a heat shunt between the soldering point and the component. See Fig. 4-3.

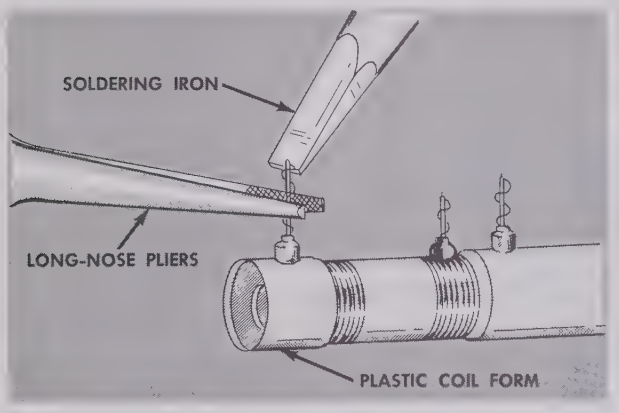


Fig. 4-3. Use long-nosed pliers to absorb excess heat when soldering to small or short-lead components.

2. Use a moderately hot iron for a short period of time.

3. Manipulate your tools with care to avoid damage to small components.

If it is necessary to hold a bare wire in place while soldering, a handy tool for this purpose can be made by tapering a 1/4-inch wooden dowel or thermoset plastic rod into a wedge shape at one end.

After soldering any connection, clip off the excess length of the soldered leads. Be sure that these ends are not dropped into the instrument where they could cause electrical shorting.

Ceramic Strip Replacement

To replace a damaged ceramic terminal strip, first unsolder all connections, then pry the mounting studs out of the chassis. The strips may also be removed by tapping the studs out from the reverse side of the chassis or by cutting off one side of each stud with diagonal cutters.

If the nylon spacers do not come out with the studs, they may be left in the chassis or pulled out separately. If undamaged, the spacers can be used with the new ceramic strip assembly. Since mounting studs are attached to replacement ceramic strips, it is not necessary to salvage the old studs.

When the damaged strip assembly has been removed, place the spacers into the mounting holes in the chassis and press the mounting studs of the new assembly into the spacers. It may be necessary to tap lightly to make the studs seat all the way down on the spacers. To avoid damage to the terminal strip, use a soft-tipped tool for tapping and apply the force directly above the mounting studs. Fig. 4-4 shows the assembled terminal strip.

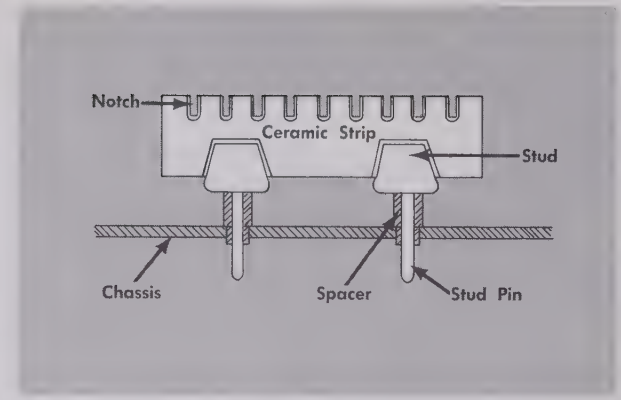


Fig. 4-4. The assembled ceramic terminal strip.

Cut off the excess length of the mounting studs extending beyond the ends of the spacers on the reverse side of the chassis. Resolder all components and wires in place (see "Ceramic Strip Soldering" suggestion given above).

Power Transformer Replacement

If a complete check of the instrument shows that the power transformer requires replacement, notify your local Tektronix Field Office. The Tektronix Field Engineer will verify the transformer failure for a warranty replacement. (See the Warranty note in the front of this manual.)

TABLE 4-1

Power Supply Resistance Checks
(Power line disconnected, plug-in units removed)

Supply (See Fig. 4-5)	Approximate Resistance
Primary	Infinite
—100 volts regulated	4 k to 13 k
+125	6 k to 22 k
+300	10 k to 38 k
—12.2	5 Ω* to 19 Ω*
+420 volts unregulated	20 k to 80 k
+475	17 k to 66 k

***Positive lead connected to ground.**

Be sure to use only the correct replacement for a power transformer. Tag the leads with the terminal numbers as they are unsoldered from the transformer to aid in connecting the new transformer. After replacing the power transformer, check the power supply (to ground) resistances given in Table 4-1, then check the calibration of the entire instrument.

Replacement of Rotary Switches

When a rotary switch is removed, tag the leads and the switch contacts with corresponding identification tags, then

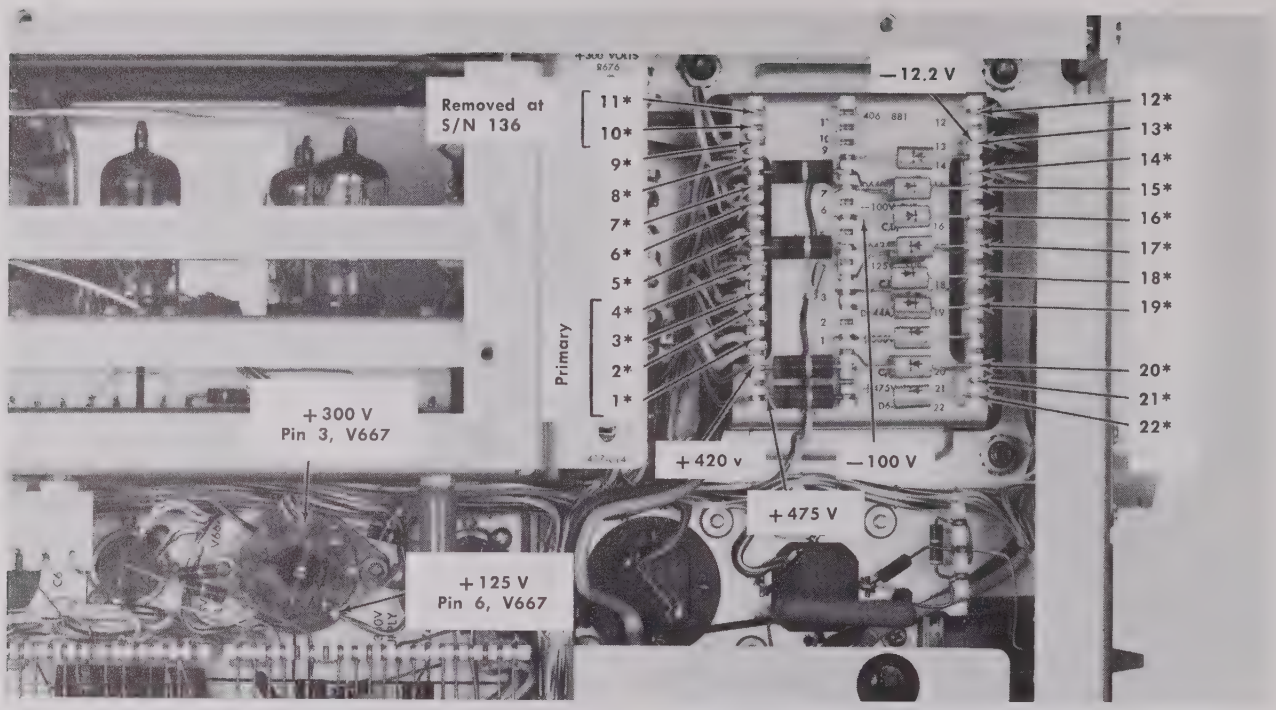


Fig. 4-5. Power transformer (T601) terminal connections (indicated by *) and power-supply resistance test points. See "Transformer Conversion" of Operating Instructions for transformer primary wiring.

use the old switch as a model for wiring the new one. The entire switch should be replaced if one section is defective. Order the switch either with or without associated components wired in place. The appropriate part numbers are given in the Parts List.

Crt Replacement

WARNING

When replacing the crt, wear goggles and heavy gloves for protection in case of an implosion.

To remove the cathode-ray tube, first disconnect the neck-pin leads, then remove the base socket and loosen the clamp at the base of the tube. (Do not disconnect the trace-alignment coil or collimation-electrode leads connected at the bottom of the shield.) Remove the graticule cover and the reflector shield and holder. Pull the crt straight out through the front panel, being careful not to bend the crt neck pins or collimating-electrode contacts. The graticule and rubber shockmount ring can be removed from the crt after it is out of the instrument.

Install the new crt by reversing the above procedure. Place the rubber shockmount ring on the crt before insertion. When the crt is properly installed, the tabs on the rubber ring fit against the front panel of the instrument. Correct position of the shield extension, grounding strip and Mylar sleeve is important when re-installing the crt. Replace these components in the positions shown in the photos (see Fig. 4-6). Note that the gap between the ends of the shield extension falls directly under the grounding strip. Tighten the base clamp screw. The color code information on the crt shield indicates the order in which the neck-pin leads are to be connected. Insert the graticule in the rubber ring, with the graticule markings on the surface next to the crt faceplate. Align the horizontal centerline with the separation line between storage screens before replacing the graticule cover.

After replacement of the crt, it will be necessary to recalibrate all circuits except the low-voltage power supplies. Refer to the Calibration section of this manual.

Recalibration After Repair

After any electrical component has been replaced, the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuits. Since the low-voltage supplies affect all circuits, calibration of the entire instrument should be checked if work has been done in the low-voltage supplies or if the power transformer has been replaced.

TROUBLESHOOTING

This portion of the Maintenance section contains information intended to aid in locating and correcting any apparent trouble that may occur in the instrument. Familiarity with normal operation can be of great assistance in locating trouble. This familiarity can be gained through the use of this instruction manual and through actual use of the instrument. The following detailed outline may be used for finding and correcting most troubes.

1. Confirm that a trouble exists.

Incorrect control settings may appear to indicate the

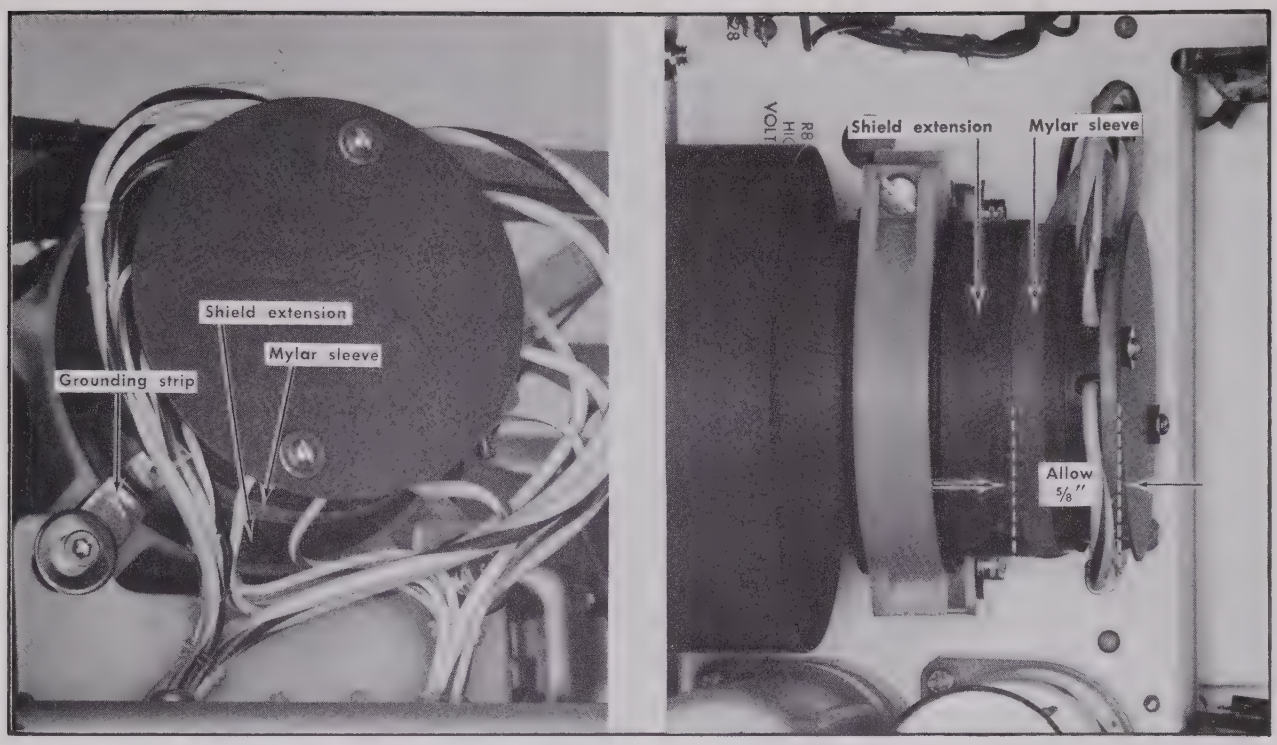


Fig. 4-6. Correct positions of shield extension and Mylar sleeve.

presence of trouble. Check first to make sure the front-panel controls are set properly for the desired mode of operation. For example, an incorrect setting of the Sweep Mode switch or Triggering Source switch on the time-base unit can indicate apparent sweep trouble, or an uncalibrated Variable control on an amplifier unit can indicate an apparent decrease in sensitivity.

2. Isolate the trouble to a unit.

Trouble can be isolated to the Type RM564, the vertical unit or the horizontal unit in one of two ways, depending on the availability of spare plug-in units.

a. If a spare vertical unit and a spare horizontal unit are available, substitute the spare units, one at a time, for those in the Type RM564 plug-in compartments. If proper operation is restored when one of the units is replaced, that unit was causing the trouble. If substitution of both plug-in units does not restore proper operation, the Type RM564 is probably at fault.

NOTE

A sampling-type plug-in unit cannot be operated with a non-sampling plug-in unit.

b. If no spare plug-in units are available, the following symptoms and checks can be used to isolate the trouble to one of the units. Set the DISPLAY switches to NON STORE and use the minimum display intensity required for each check.

(1) No trace or spot can be obtained on the crt screen.

Turn the INTENSITY control fully counterclockwise. Remove both plug-in units then turn the INTENSITY control slowly clockwise to display a spot on the screen. If no spot appears, the trouble is in the Type RM564. If a spot appears, decrease the intensity, then reinsert each unit separately. (Set the time-base unit for a free-running sweep.) After warm up set the INTENSITY control to the normal setting, then turn the Position control on the unit. If the spot or trace cannot be approximately centered on the crt screen with only one plug-in unit in the Type RM564, the trouble is probably in that plug-in unit.

(2) Deflection is insufficient and timing is incorrect.

Check the voltage supplies at the low-voltage and high-voltage test points given in the calibration procedure. If incorrect, remove one plug-in unit and recheck the voltages. Reinsert the one plug-in unit, remove the other unit and check the voltages again. If the power supply voltages became correct when either of the plug-in units was removed, the trouble is in that unit. If, however, the voltages are still incorrect regardless of which plug-in unit is removed, the trouble is in the Type RM564.

(3) Triggering is incorrect.

Check triggering from internal, line and external sources. If the line and external triggering operate correctly but internal triggering does not, the trouble is probably in the Trigger Pickoff circuit of the amplifier plug-in unit. If none of the sources provide satisfactory triggering, the trouble is probably in the time-base unit.

(4) Waveform is distorted.

Check the sweep timing. If timing is correct, the trouble is probably in the vertical amplifier plug-in unit. If the timing is incorrect, check the voltage supplies as in step (2) above.

If the trouble was found to be in either of the plug-in units, check the defective unit according to the procedure given in the instruction manual for that unit. As an aid in troubleshooting a plug-in unit, either of the units may be operated outside of the Type RM564 by extending it from the oscilloscope with a special extension cable (Tektronix part number 012-066), available through your local Tektronix Field Office.

3. Isolate the trouble to a circuit.

The source of any trouble in the Type RM564 will usually be obvious from the apparent symptoms. The normal or abnormal operation of controls will also help to locate the source of trouble. There are four basic circuits in the instrument: the low-voltage power supplies; the crt writing-gun circuit; the storage circuit; and the calibrator. The locations of these basic circuits are shown in Fig. 4-7.

Trouble in the calibrator circuit is obvious if only that circuit is malfunctioning. Trouble in the low-voltage supplies can be quickly detected by measuring the output voltages and by checking regulation and ripple as described in the calibration procedure.

NOTE

Do not adjust any of the voltage supplies unless the particular voltage is out of tolerance. Any adjustment or replacement of parts in the low-voltage supplies will necessitate a calibration check of the entire instrument.

If these supplies are all within tolerance, the trouble is either in the crt writing-gun circuit or the storage circuit. Check the crt writing-gun voltage (—3300 volts) at the high-voltage test point (see calibration procedure). If the crt voltage is correct, operate the storage controls and the writing-gun controls to determine definitely which of these circuits is causing the trouble.

4. Check tubes and transistors.

Most circuit failures are caused by electron tube or semiconductor failure due to normal aging and use. The recommended method of checking a tube or transistor is by direct substitution, since commercial testers do not indicate the circuit performance of a component. A characteristic-curve display instrument, such as a Tektronix Type 570 or Type 575, may also be useful in checking a tube or transistor that is suspected of being defective. Before installing a replacement tube or transistor, be sure that the circuit voltages are approximately normal. If replacement is made without checking the circuit, the new component may be damaged by some defect in the circuit.

Tubes and transistors that are found to operate correctly in the circuits should be returned to their original sockets. Unnecessary replacement or switching of components may require that the instrument be recalibrated.

5. Check circuit calibration.

After a trouble has been confirmed and isolated to a particular circuit, if tube or transistor checks do not locate the trouble, check the calibration of the suspected circuit according to the procedure given in the Calibration section of this manual. The calibration checks and some of the adjustments can be performed out of sequence after reading the General Information paragraphs at the first of the section.

6. Troubleshoot the circuit.

If all other checks fail to indicate the precise location of the trouble, the circuit can be checked in detail with a high-impedance voltmeter and a test oscilloscope. Voltages at various points in the instrument are given on the schematic diagrams located at the rear of this manual.

Be careful when checking inside the instrument with meter leads and probe tips. Careless shorting of leads can apply abnormal voltages or transients to the components and cause the destruction of semiconductors or other small components.

Table 4-2 relates certain specific trouble symptoms to their probable causes, and indicates some of the components that might be defective. This table should be used primarily as a guide for troubleshooting, since it does not include all possible troubles that might occur, nor all possible causes for the given symptoms. The schematic diagrams, used in conjunction with the circuit description, will suggest other checks that can be made.

Troubleshooting Aids

The assigned circuit number of each component in the Type RM564 is shown on the schematic circuit diagrams. Inside the instrument, the circuit number of each tube, transistor, electrolytic capacitor and internal control is marked on the chassis near the component to provide correlation between the symbols on the diagrams and the components in the instrument.

The rotary Calibrator switch is coded on the schematic to indicate the physical positions of the switch contacts. The number "1" indicates that the contacts are on the switch section nearest the front panel. The letters F and R indicate whether the front or the rear of the section is used to perform the particular switching function.

All wiring in the instrument is color-coded for the purpose of circuit tracing. Nearly every signal lead carries one or two colored stripes for identification. The stripes on each regulated voltage-supply lead indicate the approximate voltage carried by the lead, using the standard EIA color code. The stripes are read in order of decreasing width. As an example of the coding used, the +300-volt supply lead is coded orange (widest stripe), black and brown (narrowest stripe).

Component Checking

Components that are soldered in place can usually be checked quickly after unsoldering one end. For example, a capacitor can be checked for a leaky or shorted condition by checking its resistance on a megohm scale. The resistance

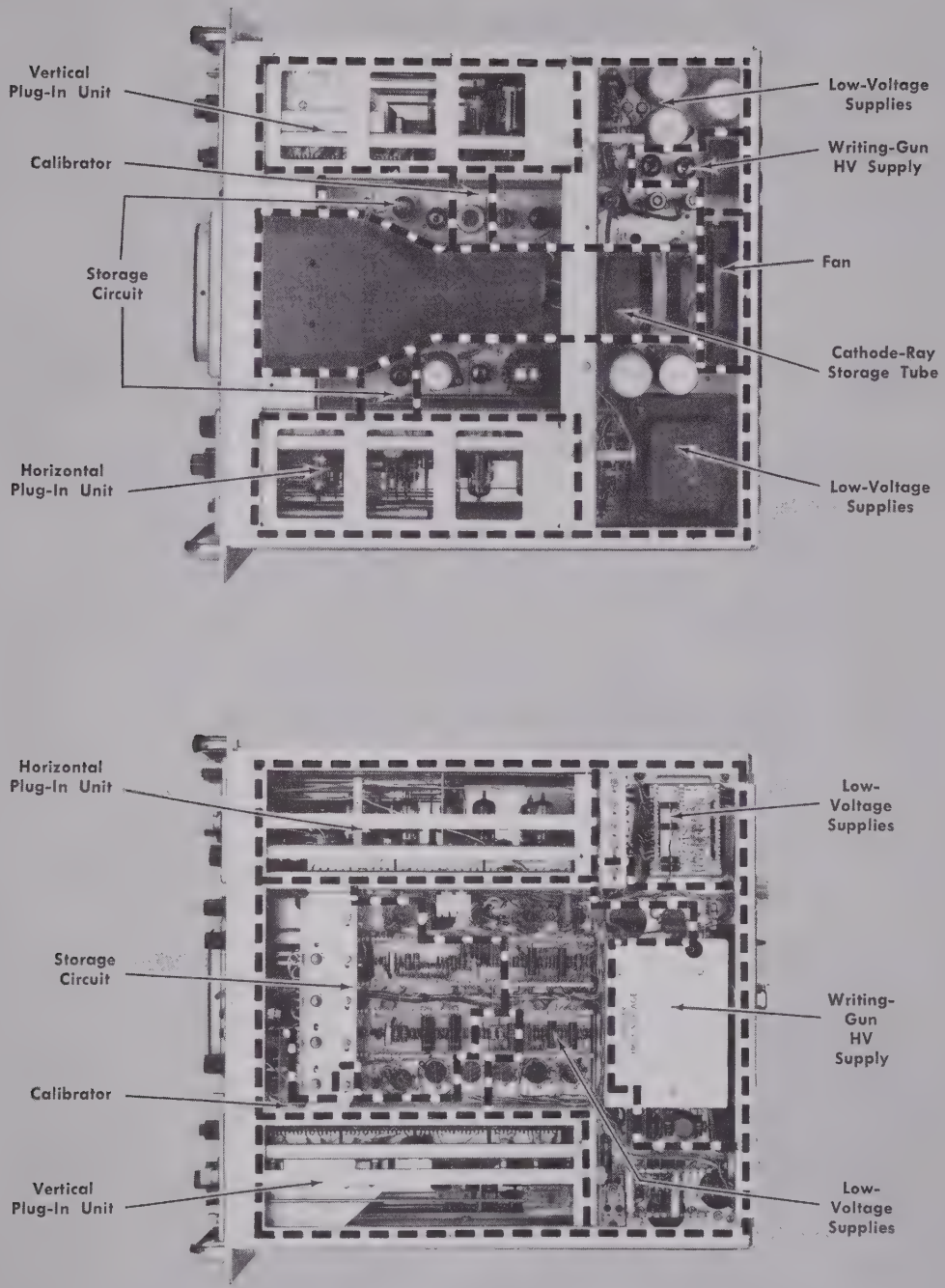


Fig. 4-7. Locations of basic circuits in the Type RM564: (a) top view, (b) bottom view.

should read infinite as soon as the capacitor is charged. An open capacitor may best be detected with a capacitance meter or by checking the waveform on each side of the component with the circuit in operation.

An open condition in a resistor or inductor can be detected by a ohmmeter continuity check. Shorted or partially shorted inductors can usually be found by analysis of high-frequency signals passing through the circuit. Partial shorting reduces the frequency response (rolloff).

A junction diode can be checked for an open or shorted condition by making an ohmmeter check between terminals. With an ohmmeter scale using an internal source of 1½ volts, the resistance should measure very high in one direction and very low in the other direction.

CAUTION

Do not use an ohmmeter scale that uses a voltage source greater than approximately 3 volts. A high voltage applied in the reverse direction may exceed the junction breakdown voltage, giving an erroneous reading and possibly damaging the semi-conductor being checked.

7. Repair and readjust the circuit.

Refer to the replacement procedures and suggestions given under "Corrective Maintenance" (earlier in this section) when repairing any trouble found in the instrument. Be sure to check the calibration of any circuit that has been repaired or has had tubes or transistors replaced.

TABLE 4-2

Troubleshooting

Low-Voltage Supplies (Any changes in these circuits may change instrument calibration.)					
Symptoms	Checks	—100-volt Supply	+125-volt Supply	+300-volt Supply	—12.2-volt Supply
1. Incorrect output level, ripple or regulation.	A. Check line voltage. (105 to 125 volts or 210 to 250 volts.) Do not attempt to operate instrument on incorrect voltage.				
	B. Check voltage adjustment. (Voltage check points given in Calibration section.) Check instrument calibration if setting is changed.	—99 to —101 volts; R616 (—100 VOLTS).	+123.5 to +126.5 volts; R656 (+125 VOLTS).	+297 to +303 volts; R676 (+300 VOLTS).	—12.1 to —12.3 volts; R730 (—12.2 VOLTS).
	C. Check outputs of other supplies for voltage, ripple and regulation.	Check +125 V supply.	Check —100 V, +300 V supplies.	Check —100 V, +125 V supplies	Check —100 V, +125 V, +300 V supplies.
	D. Check tubes and transistors by substitution, one at a time. Install good component if substitution corrects trouble. Recalibrate circuit.	V609, V634, Q624, V627.	V654, V667.	V674, V667.	Q734, Q744, Q757, F720.
	E. If output is still not corrected, check additional symptoms given below.				
2. Output voltage too high or too low.	A. Perform checks 1A, 1C and 1D.				
	B. Check ac voltage between terminals on power transformer T601. (Voltages on schematic; terminals shown in Fig. 4-5.) If incorrect, check transformer primary.	Terminals 15 and 16.	Terminals 17 and 18.	Terminals 19 and 20.	Terminals 12 and 13, 13 and 14.

Low-Voltage Supplies (Cont'd)					
Symptoms	Checks	−100-volt Supply	+125-volt Supply	+300-volt Supply	−12.2-volt Supply
	C. Check voltage at rectifier output. (Voltages on schematic.) If incorrect, check rectifier diodes, electrolytic capacitors, series resistors.	Check D640, C640A, C640B, R640.	Check D642, C642A, C642B, R642.	Check D644, C644, C667, R644.	Check D720, D721, C720, C757.
	D. Check input voltages to error amplifier. (Voltages on schematic.) If incorrect, check resistors, potentiometers and capacitors in divider circuits.	Pins 7 and 2, V634.	Pins 1 and 6, V654.	Pins 1 and 6, V674.	Base, Q734.
	E. Check feedback components.	C616, R635.	C650, R650.	C670, R670.	R744, R737, C737.
3. Poor regulation (±2% tolerance).	A. Perform checks 1B, 1C and 1D.				
	B. Check voltage at plate (or emitter) of series regulator. (Voltages on schematic.) If incorrect, substitute other plug-in units, check output resistor, check shunt resistors in plug-in units.	Pin 3, V627. Check R628, R629.	Pin 2, V667. Check R666.	Pin 5, V667. Check R667, R668.	Emitter, Q757.
4. Excessive ripple.	A. Perform checks 3B, 1A, 1B, 1C and 1D.				
	B. Check ripple at plate (or emitter) of series regulator. If excessive, check rectifier and electrolytic capacitor.	Pin 3, V627; 5 v max. Check D640, C640A.	Pin 2, V667; 8 v max. Check D642, C642A.	Pin 5, V667; 12 v max. Check D644, C644.	Emitter, Q757; 2 v max. Check D720, D721, C720.
	C. Perform check 2E.				

Crt (Writing Gun) Circuit	
Symptoms	Checks
5. Any incorrect operation of writing gun circuit.	Preliminary: Set DISPLAY switches to NON STORE for protection of storage screens. A. Check line voltage and low-voltage supplies. (See checks 1A and 1B). B. Check B856 and B857. If glowing brightly, V822 or V832 is probably inoperative. Check crt cathode and grid voltages. (See schematic diagram.) Check C822, C842, C830, C832. C. Check HIGH VOLTAGE (R841) adjustment. See calibration procedure. D. Check heaters of V822 and V832 for color: dull orange—normal. bright—heavy load on either tube. Check for source of loading. dim—poor tube. Replace, then recalibrate high-voltage adjustment. both dark—oscillator or regulator inoperative. E. Check V800 and V814 for heater glow. F. Check V800 and V814 by substitution, one at a time. Install good tube if substitution corrects trouble. Readjust high voltage. G. If operation has still not been corrected, check for additional symptoms as in checks 6 through 13.
6. No intensity.	A. Check INTENSITY control setting. B. Perform checks 5A through 5F.

Crt (Writing Gun) Circuit *(Cont'd)*	
Symptoms	Checks
	C. Make sure sweep is not held off by horizontal unit. (Deflection-blanking voltage is applied except during sweeps.) D. Make sure spot or trace is not positioned off-screen by vertical or horizontal plug-in unit. With both plug-in units removed and horizontal deflection plates shorted together, spot should appear near center of screen. **CAUTION** **When removing plug-in units have DISPLAY switches set to NON STORE, spot defocused and INTENSITY control turned counterclockwise. Increase intensity slowly to display spot on crt screen.**
7. Low intensity.	A. Check INTENSITY control setting. B. Perform checks 5A through 5F. C. Check unblanking waveform at pin 22 of horizontal plug-in connector. Sweep gate signal should be approximately +125 volts during the entire sweep. D. With power off, check high-voltage divider (R847, R840 through R846).
8. High intensity.	A. Check INTENSITY control setting. B. Perform checks 5B through 5F. C. With power off, check resistors and capacitors in grid-bias circuit (R831 through R836, C830, C832, C837).
9. Poor astigmatism and/or focus.	A. Check ASTIG and FOCUS control settings. B. Perform check 5C. C. Check voltage at pin 8 of crt. Should change from +300 to 0 volts as ASTIG control is rotated. If incorrect, check R864 and the +300 volts to R864.
10. Blooming (increase in display size and intensity).	Perform checks 5D, 5E and 5F.
11. No intensification of delaying sweep.	In Normal mode, check voltage at junction of D838, D839 for +0.3 to +0.6 volt. May damage delayed-sweep unit if greater than +0.6 volt. Check R838 and D838.
12. No (external) intensity modulation.	Check C853 and R853.
13. Undesired intensity modulation.	A. Make sure ground bar is connected to EXT CRT CATHODE jack. B. Check D838 and D839.
Storage Circuit	
Symptoms	Checks
14. Any incorrect operation of storage functions.	Preliminary: Set DISPLAY switches to STORE to establish operating voltages. A. Check upper and lower screen voltages, given on schematic. B. Check V913 by substitution. Install good tube if substitution corrects trouble, then recalibrate storage circuit. C. Check line voltage and low-voltage supplies (checks 1A and 1B). D. Check unregulated +475-volt supply at pin 1, V913. E. Check +355-volt supply at B903. F. Check collimation-electrode voltages, given on schematic. G. Check calibration of storage and non-storage levels. (See calibration procedure.) H. If operation is still incorrect, check for additional symptoms as given in checks 15 through 25.
15. Flood guns inoperative.	A. Check voltages at crt pins 6 and 11 and at center (ORANGE) neck pin. (Voltages given on schematic.)

Storage Circuit *(Cont'd)*	
Symptoms	**Checks**
	B. Check flood-gun heater (pins 10 and 11) for continuity, with power off and base disconnected. C. Perform checks 14A and 14G. D. Check D948, SW948.
16. Screen does not store.	Perform checks 14A and 14G.
17. Screen does not store single-sweep displays.	A. Check INTENSITY control setting. B. Make sure sweep speed does not exceed writing speed (see operating instructions).
18. Screen does not erase.	A. Check erase multivibrator voltages given on schematic. B. Check V955 (or V965) by substitution. C. Check for erase pulse on both sides of C916 (or C918).
19. Image cannot be completely erased.	See crt precautions given in Operating Instructions section, "Care of Storage Screens".
20. Screen has poor contrast.	A. Perform checks 14A and 14G. B. Make sure WRITING RATE INCREASE switch is turned off. (If in use, turn control to a lower setting.)
21. Background brightens after storing.	A. Perform check 14G. B. Check collimation-electrode adjustments. (See calibration procedure.)
22. INTEGRATE button changes crt deflection factor.	A. Check R948 and R848. B. Check C849 and D849. C. Check INTEGRATE switch (SW948).
23. INTEGRATE button inoperative.	A. Check voltage at junction of R948, R848. Should be approximately +270 volts normally; approximately +8 volts with INTEGRATE button pressed. B. Check INTEGRATE switch (SW948).
24. LOCATE button does not locate trace position.	A. Make sure sweep is held off and INTENSITY control is set slightly below normal (see operating instructions). B. Check B903 and R865. C. Check LOCATE switch (SW868).
25. WRITING RATE INCREASE inoperative.	A. Check for sync pulse at pin 4 of horizontal plug-in unit. B. Check pulse at center arm of R984. Pulse should be between —30 and —80 volts in amplitude and should range in width from 1 to 6 msec as control is rotated through its range. C. Check Q975 and Q985 by substitution. D. Check D972 and D973. E. Check WRITING RATE INCREASE switch (SW977).
	Calibrator
Symptoms	**Checks**
26. No output.	A. Check V884 for heater glow. B. Check V884 by substitution. Install good tube if substitution restores proper operation, then recalibrate CAL AMPL adjustment. C. Check for line-frequency waveform at C876. D. Check circuit voltages given on schematic.
27. Incorrect output amplitude.	A. Make sure output is not loaded with low impedance. (Amplitudes are correct only for high-impedance loads.) B. Check CAL AMPL adjustment. (See calibration procedure.) C. Perform checks 26B and 26D.

	Calibrator *(Cont'd)*
Symptoms	Checks
	D. Check output divider. (See calibration procedure.)
28. Non-symmetrical output.	A. Perform checks 26B through 26D. B. Check C879.

SECTION 5

CALIBRATION

General Information

The Type RM564 should be serviced and recalibrated after each 500 hours of operation (at least once every 6 months) to insure that it is operating properly and accurately. In addition, certain portions of the instrument must be recalibrated after tubes or transistors have been replaced or repair have been made. See the Maintenance section of this manual for servicing and repair information.

In the instructions that follow, the steps are arranged in convenient sequence to avoid unnecessary repetition. Each step that begins with the word "Check" is a performance or quality check that does not require an adjustment. Omit the "Check" steps if you desire only an adjustment procedure. If individual steps are to be performed out of sequence, you will have to note the control settings and equipment connections used in preceding steps. Also, be sure to check any subsequent steps that might be affected by adjustments you have made. Power supply adjustments and crt replacement will affect the entire instrument.

Always calibrate the Type RM564 with two plug-in units installed. When calibrating the entire system, start with the indicator unit (Type RM564), then calibrate the amplifier unit and the time-base unit. Either plug-in unit can also be calibrated separately, but always begin the procedure by checking the Type RM564 power supply voltages.

Do not preset any internal controls unless they are suspected of being grossly misadjusted, or unless repairs have been made in the circuit. In these cases, set the particular internal controls to midrange.

Equipment Required

The following (or equivalent) items of equipment are required for a complete calibration of the Type RM564 Oscilloscope:

1. Tektronix 2-Series or 3-Series Amplifier plug-in unit (non-sampling). Bandpass to at least 1 Mc; deflection factors from 0.05 to 10 volts/div. Dual-trace or multi-trace unit preferred if available, for checking alternate-trace switching and chopped blanking.

2. Tektronix 2-Series or 3-Series Time-Base plug-in unit (non-sampling). Sweep rates to at least 1 μsec/div; single-sweep capability; external horizontal input.

3. Tektronix 3-Series Time-Base plug-in unit with delayed-sweep feature, required only for checking delaying-sweep intensification. This unit may be used instead of item 2 for the entire procedure if it also has single-sweep capability and external horizontal input.

4. Square-wave generator. Output frequencies from 50 cps to 1 Mc; output amplitudes from 100 mv to at least 10 volts into 50 ohms. Tektronix Type 105 recommended.

5. Variable autotransformer. Output voltage variable from 105 to 125 volts ac rms for nominal 117-volt operation or from 210 to 250 volts for nominal 234-volt operation; output power 250 watts minimum.

6. Test oscilloscope. Bandpass from dc to at least 1 Mc; deflection factors from 0.01 (or less) to 20 volts/div; sweep rates to at least 1 μsec/div; ac and dc input coupling; voltage and timing accuracy $\pm$3%. Tektronix 560-Series Oscilloscope with Type 3A1 and Type 2B67 Plug-In Units recommended, or Tektronix 530-, 540- or 550-Series Oscilloscope with Type 1A1, L, D, B, or H Plug-In Unit.

7. 10X Attenuator probe for test oscilloscope. Tektronix P6006 Probe recommended.

8. 1X Test probe for checking power-supply ripple. Tektronix P6028 Probe recommended. A clip-lead adapter (Tektronix part number 013-076 for BNC, 013-003 for UHF) with a coaxial cable may be substituted for the 1X probe.

9. Dc voltmeter. Voltage ranges from 0 to 3300 volts; impedance at least 20,000 Ω/volt; accuracy $\pm$1% from 0 to 300 volts, $\pm$3% at 3300 volts.

10. Ac voltmeter, for monitoring autotransformer output. Voltage range up to 150 volts ac rms (or up to 250 volts for 234-volt operation); accuracy $\pm$3%.

11. Ac voltmeter, for checking heater voltage. Range from 0 to 10 volts ac rms; accuracy $\pm$3%.

12. Ohmmeter, for checking continuity. Required only if amplifier plug-in unit is not a dual-trace or multi-trace unit.

13. Ammeter, for measuring beam current. Range from 0 to 60 μamps; accuracy $\pm$3% at 60 μamps. Required for writing-speed measurement.

14. Two coaxial cables. Characteristic impedance 50 to 52 ohms; length approximately 42 inches. Tektronix part number 012-057 for BNC, 012-001 for UHF.

15. Three patch cords with banana jacks at both ends. Length approximately 18 inches. Tektronix part number 011-049.

16. 50-ohm termination. BNC connectors. Tektronix part number 011-049 recommended.

17. Plastic screwdriver-type adjustment tool. Tektronix part number 003-000 (1½-inch shaft) recommended.

18. Connector adapters as needed for connecting between instruments:

UHF plug to BNC jack. Tektronix part number 103-015.
BNC plug to UHF jack. Tektronix part number 103-032.
BNC plug to binding-post. Tektronix part number 103-033.

19. Two 2-inch sections of bare 22-gauge wire, for checking remote erase.

20. Capacitance meter or Type 3M1 Deflection Capacitance Normalizer plug-in unit, required only for adjusting deflection capacitance if crt has been replaced. Meter accuracy $\pm$3% at 14 pf.

21. Photometer, for checking stored brightness and contrast ratio. Required only if these checks are needed. Meter

range from 0.5 to 10 foot-lamberts. Spectral response of meter must be corrected for spectrum of crt phosphor (P200 or P201). Light sensor must be capable of being placed against face of crt.

PRELIMINARY PROCEDURE

The following preliminary steps are performed before beginning the calibration procedure:

1. Extend the Type RM564 from the rack or place it on a test bench. Orient the instrument to provide access to adjustment controls on the bottom.

2. Remove the top and bottom panels from the Type RM564.

3. Insert the amplifier plug-in unit in the left (vertical) plug-in compartment and the time-base plug-in unit in the right (horizontal) plug-in compartment.

4. Connect the test instruments and autotransformer to the line voltage.

5. Connect the output of the autotransformer to the Type RM564.

6. Install the 1X probe on the vertical input of the test oscilloscope.

7. Set front-panel controls:

Type RM564

FOCUS	Centered
INTENSITY	Counterclockwise
CALIBRATOR	OFF
Upper DISPLAY	NON STORE
Lower DISPLAY	NON STORE
SCALE ILLUM	POWER OFF
WRITING RATE INCREASE	Off (pushed in)
CRT CATHODE SELECTOR	EXT CRT CATHODE

Amplifier Unit

Input signal	None
Mode	Normal (Channel 1)
Volts/Div	5
Input coupling	AC
Position	Centered

Time-Base Unit

Input signal	None
Time/Div	5 μsec
Mode	Single Sweep
Triggering	+ Internal, free run
Position	Centered

Test Oscilloscope

Horiz. mode	Normal
Sweep rate	5 msec/div
Triggering	+Line, auto
Vertical mode	Normal (Channel 1)
Deflection factor	.01 volts/div
Input coupling	AC

At the beginning of each step the control settings and interconnections are assumed to be the same as they were at the end of the preceding step unless otherwise noted.

8. Turn on the test instruments and the Type RM564 and set the autotransformer for design-center voltage of the Type RM564 (117 or 234 volts). Monitor the autotransformer output with the 150-volt (or 250-volt) ac meter.

9. Allow at least 10 minutes warm up before making any checks or adjustments.

10. Read over the crt precautions in the Operating Instructions section ("Care of Storage Screens") before starting the calibration procedure.

POWER SUPPLY AND CRT CIRCUITS

1. Adjust Low-Voltage Supplies

Refer to Table 5-1 for output voltage, regulation and ripple tolerances during the following checks. Make adjustments in the sequence given in the table. Test points and adjustment controls are shown in Fig. 5-1.

NOTE

If you are not performing a complete recalibration, do not adjust any of the low-voltage supplies unless they are out of tolerance. Adjustment of these controls will necessitate a calibration check of the entire instrument.

a. Connect the dc voltmeter between chassis ground and the test point of each supply. Adjust the appropriate control if the output voltage is not within the specified tolerance.

b. Connect the dc voltmeter to each test point and vary the autotransformer output voltage from 105 to 125 volts (or 210 to 250 volts). The output of each supply should remain within the specified regulation tolerance.

c. Connect the 1X test probe to each test point and check for power supply ripple with the test oscilloscope. Be sure the test probe is properly compensated.

d. Vary the autotransformer output voltage from 105 to 125 volts (or 210 to 250 volts) and check for ripple and regulation. Ripple should not exceed the maximum given in Table 5-1.

e. Disconnect the probe.

f. Return the autotransformer output voltage to the design-center line voltage of the Type RM564 (117 or 234 volts).

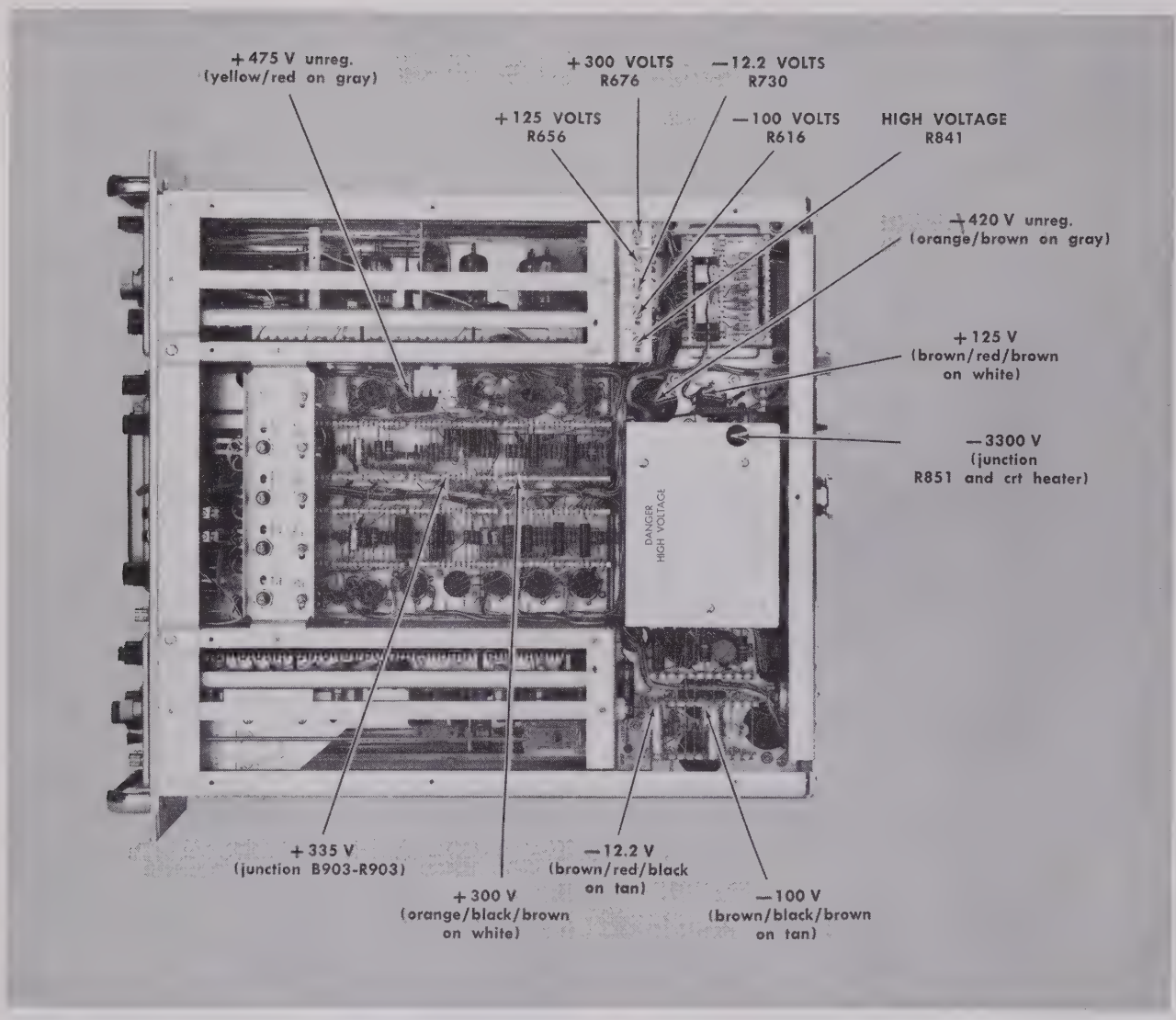


Fig. 5-1. Voltage test points and adjustments on bottom of Type RM564.

TABLE 5-1

Low-Voltage Supplies

Supply	Tolerance at 117 V (234 V)	Regulation 105-125 V (210-250 V)	Adjust	Ripple (Max.)
—100 volts	±1.0 volt	±2.0 volts	R616 (—100 VOLTS)	7 mv
+125 volts	±1.5 volts	±3.0 volts	R656 (+125 VOLTS)	14 mv
+300 volts	±3.0 volts	±6.0 volts	R676 (+300 VOLTS)	110 mv
—12.2 volts	±0.1 volt	±0.25 volt	R730 (—12.2 VOLTS)	4 mv

2. Check Unregulated Supplies

a. Connect the dc voltmeter between each unregulated voltage test point (see Fig. 5-1) and ground.

b. Check for correct voltages, as follows:

+355 volts ±15 volts*
+420 volts ±42 volts
+475 volts ±48 volts

3. Check Heater Voltages

a. Connect the 0-10-volt ac voltmeter between terminals 8 and 9 of T601. (See Maintenance section for terminal locations.)

b. Check for a heater voltage of 6.3 volts (±0.7 volts) ac rms.

c. Connect the ac meter between terminals 5 and 6 of T601. (Caution: This supply is elevated to +125 volts.)

d. Check for 6.3 volts (±0.7 volts) ac rms.

e. Do not check the crt heater voltage, elevated to —3300 volts.

4. Adjust High Voltage

a. Connect the dc voltmeter between the —3300-volt test point (see Fig. 5-1) and ground.

b. Check for —3300 volts (±100 volts).

c. Adjust R841 (HIGH VOLTAGE) if required.

d. Disconnect the voltmeter.

5. Check Alternate Trace

a. If a dual-trace or multi-trace amplifier plug-in unit is used:

(1) Reset the following controls:

Amplifier Mode	Alternate
Channels 1 and 2	On
Time-base Mode	Normal

(2) Set the Type RM564 INTENSITY control for normal display brightness and check for two traces on the crt screen.

b. If a single-trace amplifier plug-in unit is used:

(1) Turn off the Type RM564.

(2) Remove both plug-in units temporarily.

(3) Make an ohmmeter continuity check between pin 4 of the interconnecting jack in the vertical plug-in compartment and pin 3 of the interconnecting jack in the horizontal plug-in compartment. Also check for continuity between pin 3 of the vertical interconnecting jack and pin 4 of the horizontal interconnecting jack and for infinite resistance between pins 3 and 4 of the vertical plug-in jack. Since the Type RM564 merely interconnects the two plug-in units in Alternate mode, these continuity checks also check the alternate-trace function.

(4) Perform steps 6b(1) through 6b(7) before reinserting the plug-in units.

*The +355-volt source is regulated through the +300-volt supply.

6. Check Dual-Trace Blanking

a. If a dual-trace of multi-trace amplifier plug-in unit is used:

(1) Reset the following controls:

Amplifier Mode	Chopped
Time/Div	2 μsec
CRT CATHODE SELECTOR	EXT CRT CATHODE

(2) Focus the display.

(3) Position the two traces about 2 major divisions apart on the crt screen.

(4) Trigger the chopped waveform.

(5) Adjust the INTENSITY control so the vertical segments of the chopped waveform are barely visible.

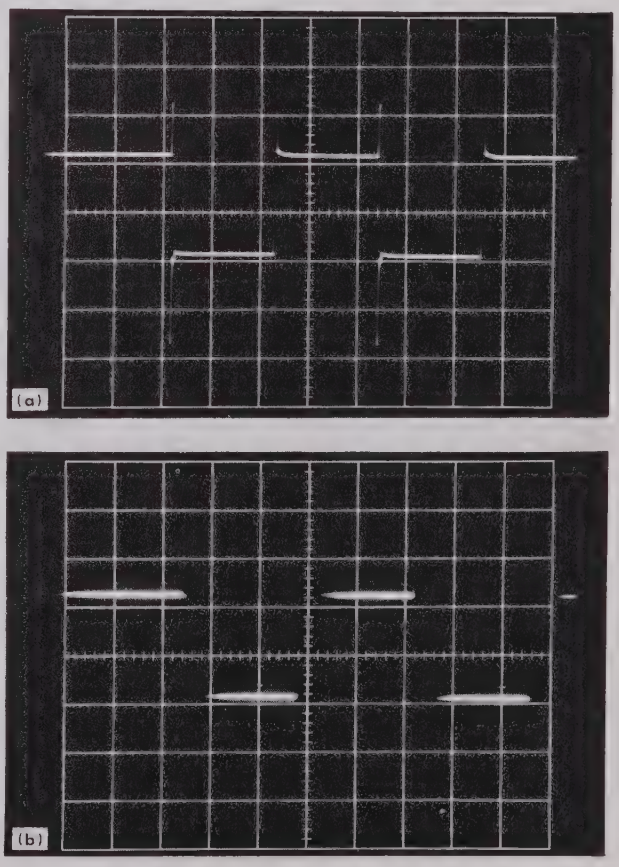


Fig. 5-2. Dual-trace blanking check with dual-trace unit in Chopped mode. Waveforms with CRT CATHODE SELECTOR switch set at: (a) EXT CRT CATHODE; (b) CHOPPED BLANKING.

(6) Move the CRT CATHODE SELECTOR switch to CHOPPED BLANKING.

(7) Note the change produced in the display. The vertical segments should now be blanked and the horizontal segments should be intensified. (See Fig. 5-2).

(8) Return the CRT CATHODE SELECTOR switch to EXT CRT CATHODE position.

(9) Turn the INTENSITY control fully counterclockwise.

b. If a single-trace amplifier plug-in unit is used:

(1) (With power off and amplifier plug-in unit removed) connect the ohmmeter between pin 24 of the inter-connecting jack in the vertical plug-in compartment and the center terminal of switch SW854 (CRT CATHODE SELECTOR).

(2) Check for a meter reading of infinite (open circuit) with the switch in the EXT CRT CATHODE position.

(3) Set the CRT CATHODE SELECTOR switch to CHOPPED BLANKING.

(4) Check for a meter reading of zero (closed circuit). Together with the following external-cathode intensity modulation check, this continuity check tests the chopped blanking function of the Type RM564.

(5) Disconnect the ohmmeter.

(6) Reinsert the plug-in units into the Type RM564.

(7) Turn on the oscilloscope and allow a few minutes for the instrument to warm up again.

7. Check External Crt Cathode

a. Reset the following controls:

Amplifier Mode	Normal (Channel 1)
Time-base Mode	Normal
Time/Div	5 μsec
CRT CATHODE SELECTOR	CHOPPED BLANKING

b. Disconnect the grounding bar from the EXT CRT CATHODE jack.

c. Install a 50-ohm termination on the output of the Type 105 Square-Wave Generator.

d. Set the Type 105 for minimum output amplitude and an output frequency of 100 kc.

e. Connect the Type 105 output to the amplifier unit input connector (Channel 1) and to the EXT CRT CATHODE connector. Use three patch cords and adapters as necessary.

f. Adjust the INTENSITY control for normal brightness.

g. Focus the free-running display.

h. Adjust the Type 105 output amplitude to produce approximately 2 major divisions of deflection.

i. Trigger the square-wave display. (Some ringing may be apparent on the waveform due to the unshielded leads.)

j. Decrease the intensity until the waveform is barely visible.

k. Set the CRT CATHODE SELECTOR switch to EXT CRT CATHODE. The top portions of the waveform should be blanked completely and the bottom portions should be intensified.

l. Set the switch to CHOPPED BLANKING again.

m. Set the amplifier unit Volts/Div switch to 1.

n. Adjust the Type 105 output amplitude to produce 3 major divisions of deflection.

o. Move the signal lead from the amplifier input to the external trigger input of the time-base unit.

p. Set the time-base unit for external triggering.

q. Trigger the sweep.

r. Set the CRT CATHODE SELECTOR switch to EXT CRT CATHODE. Appreciable intensity modulation should be visible with the 3-volt signal applied. (See Fig. 5-3.)

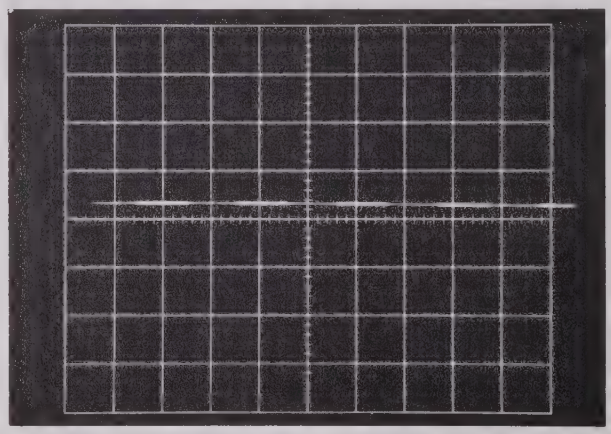


Fig. 5-3. External Crt Cathode check showing intensity modulation.

s. Remove the patch cords and adapters.

t. Reconnect the grounding bar to the EXT CRT CATHODE jack. Leave the switch in the EXT CRT CATHODE position.

8. Adjust Trace Alignment

a. Reset the time-base controls:

Time/Div	1 msec
Triggering	+ Internal, free run

b. Position the trace at the center of the crt screen.

c. Focus the trace.

d. Adjust the front-panel TRACE ALIGNMENT screwdriver control to align the trace with the horizontal graticule centerline.

9. Check Crt Vertical Deflection Factor

a. Connect the dc voltmeter (200-volt scale) between the two vertical deflection-plate neck pins (BLUE and BROWN leads). Do not short to the crt shield.

b. Position the trace to the top graticule line.

c. Note and record the meter reading.

d. Position the trace to the bottom graticule line.

e. Again note and record the meter reading.

f. Determine the voltage swing over the 8 major divisions. This should be between 144 and 168 volts, representing a crt vertical deflection factor between 18 and 21 volts/div.

10. Check Crt Vertical Electrical Center

a. With the voltmeter connected between the vertical deflection-plate neck pins, position the trace near the center of the crt.

b. Note the vertical position of the trace when the meter reads zero volts. This is the crt vertical electrical center. The trace should now be within 1 major division of the graticule centerline.

c. Disconnect the voltmeter.

11. Check Crt Horizontal Deflection Factor

a. Turn the INTENSITY control fully counterclockwise.

b. Set the time-base unit for external horizontal input.

c. Connect the dc voltmeter (200-volt scale) between the two horizontal deflection-plate neck pins (GREEN and RED leads). Do not short to the crt shield.

d. Adjust the INTENSITY control to display a dim spot on the crt screen.

e. Position the spot to the left edgeline of the graticule.

f. Note and record the meter reading.

g. Position the spot to the right edgeline of the graticule.

h. Again note and record the meter reading.

i. Determine the voltage swing over the 10 major divisions. This should be between 170 and 200 volts, representing a crt horizontal deflection factor between 17 and 20 volts/div.

12. Check Crt Horizontal Electrical Center

a. With the voltmeter connected between the horizontal deflection-plate neck pins, position the spot near the center of the crt.

b. Note the horizontal position of the spot when the meter reads zero volts. This is the crt horizontal electrical center. The spot should now be within 1 major division of the vertical centerline.

c. Disconnect the voltmeter.

13. Check Delaying Sweep Intensification

This check can be made only with a time-base unit having the delayed-sweep feature.

a. Turn the INTENSITY control fully counterclockiwse.

b. Remove the one-sweep time-base unit.

c. Check the voltage at the junction of D838 and D839. Should not be higher than +0.6 volts. (Do not insert delayed-sweep unit if voltage exceeds +0.6 volts.)

d. Install the delayed-sweep time-base unit in the horizontal plug-in compartment. Allow about 3 minutes for warm up.

e. Set the time-base front-panel controls:

Mode	Normal
Normal Sweep rate	1 msec/div.
Normal Triggering	Free run (auto)
Delayed Sweep rate	.1 msec/div.
Delayed Triggering	Free run
Delay time	Centered

f. Set the Type RM564 INTENSITY control for a trace of normal brightness.

g. Switch the time-base Mode switch to Intensified. Only the intensified portion of the delaying (normal) sweep should now be visible on the crt screen.

h. Turn the Delay Time control. The intensified portion of the trace should move smoothly across the screen.

i. Turn the INTENSITY control fully counterclockwise.

j. Remove the delayed-sweep time-base unit and reinsert the time-base unit used for previous steps.

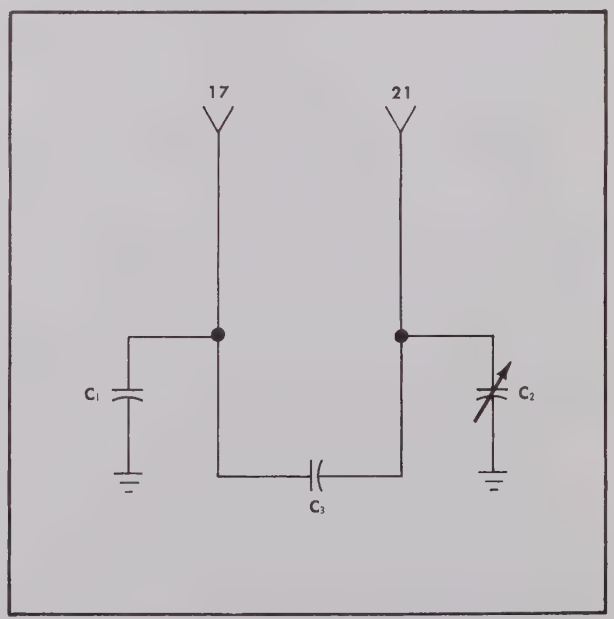


Fig. 5-4. Schematic representation of effective crt deflection-plate capacitance. C_1 and C_2 are capacitances from each plate to ground; C_3 is total capacitance between deflection plates.

14. Adjust Deflection Capacitance

Omit this step unless the crt has been replaced.

After installation of a new crt, the effective deflection-plate capacitance must be adjusted to a standard value with trimmer capacitors C760 and C761. These adjustments can be made either with a Tektronix Type 3M1 Crt Deflection Capacitance Normalizer plug-in unit or (less directly) through the use of a capacitance meter. To use a Type 3M1 for the adjustments, refer to the instruction manual for that unit. The following procedure describes the method of adjustment using a capacitance meter.

Since the deflection plates are driven push-pull, their effective capacitance as seen by the plug-in unit cannot be measured directly. It can, however, be calculated from the measured circuit capacitances represented schematically in Fig. 5-4.

a. Preliminary

(1) Turn off the Type RM564 and disconnect the power cord.

(2) Insulate the oscilloscope chassis from earth ground.

(3) Remove both plug-in units.

b. Vertical Deflection Capacitance

(1) Connect the guard voltage lead of the capacitance meter to pin 21 of the interconnecting jack in the vertical plug-in compartment.

(2) Measure the capacitance between pin 17 and the oscilloscope chassis. This is the value of C_1 in Fig. 5-4.

(3) Connect the guard voltage lead to the oscilloscope chassis.

(4) Measure the capacitance between pins 17 and 21 of the interconnecting jack. This is the value of C_3 in Fig. 5-4.

(5) Substitute the measured values for C_1 and C_3 in equation (2) below and solve for the value of C_3. Effective deflection-plate capacitance (C_{eff}) should be 14.3 picofarads (factory standard).

$$C_{eff} = \frac{C_1 + C_2}{2} + 2\,C_3 \qquad \text{Equation (1)}$$

$$C_2 = 28.6\,\text{pf} - C_1 - 4\,C_3 \qquad \text{Equation (2)}$$

(6) Connect the guard voltage lead to pin 17 of the interconnecting jack.

(7) Measure the capacitance between pin 21 and the oscilloscope chassis. This should be equal to the calculated value of C_2.

(8) Adjust C760 if the measured value does not equal the calculated capacitance for C_2. C760 is mounted just above the interconnecting jack at the rear of the vertical plug-in compartment.

c. Horizontal Deflection Capacitance

(1) Using the procedure just described [steps b(1) through b(8)], connect the capacitance meter to the appropriate pins of the horizontal plug-in jack and determine the value of C_2 for the horizontal deflection plates.

(2) Connect the guard voltage lead to pin 17 of the interconnecting jack.

(3) Measure the capacitance between pin 21 and the oscilloscope chassis. This should be equal to the calculated value of C_2.

(4) Adjust C761 if the measured value does not equal the calculated capacitance for C_2. C761 is mounted just above the interconnecting jack at the rear of the horizontal plug-in compartment.

(5) Disconnect the capacitance meter.

CALIBRATOR CIRCUIT

15. Adjust Calibrator Amplitude

a. If the plug-in units were removed and power disconnected to adjust the crt deflection-plate capacitance, reinsert the plug-in units, connect the design-center line voltage and turn on the power. Allow about 10 minutes for warm up.

b. Check that the CALIBRATOR switch is set to OFF.

c. Connect the dc voltmeter (100-volt range) between pin 7 of V884 and ground.

d. Adjust R871 (CAL AMPL) for a meter reading of +100 volts. The location of R871 is shown in Fig. 5-5.

16. Check Calibrator Symmetry

a. With the dc voltmeter connected to pin 7 of V884, set the CALIBRATOR switch to 1 mV.

b. Check for meter reading between 40 and 60 volts, indicating waveform symmetry of 40:60 or better.

c. Set the CALIBRATOR switch to each of its 6 positions and check symmetry. See the troubleshooting table in the Maintenance section if the voltage reading is not in the 40- to 60-volt range.

d. Disconnect the voltmeter.

17. Check Calibrator Risetime

a. Set the CALIBRATOR switch to 100 V.

b. Install the 10X attenuator probe on the test oscilloscope vertical input.

c. Set the test oscilloscope controls:

Horiz. mode	Normal
Sweep rate	1 μsec/div
Triggering	+ Internal
Vertical mode	Normal (Channel 1)
Deflection factor	5 volts/div
Input coupling	DC

d. Connect the probe tip to the CAL OUT connector.

e. Trigger the test oscilloscope display to observe the rising portion of the Calibrator waveform.

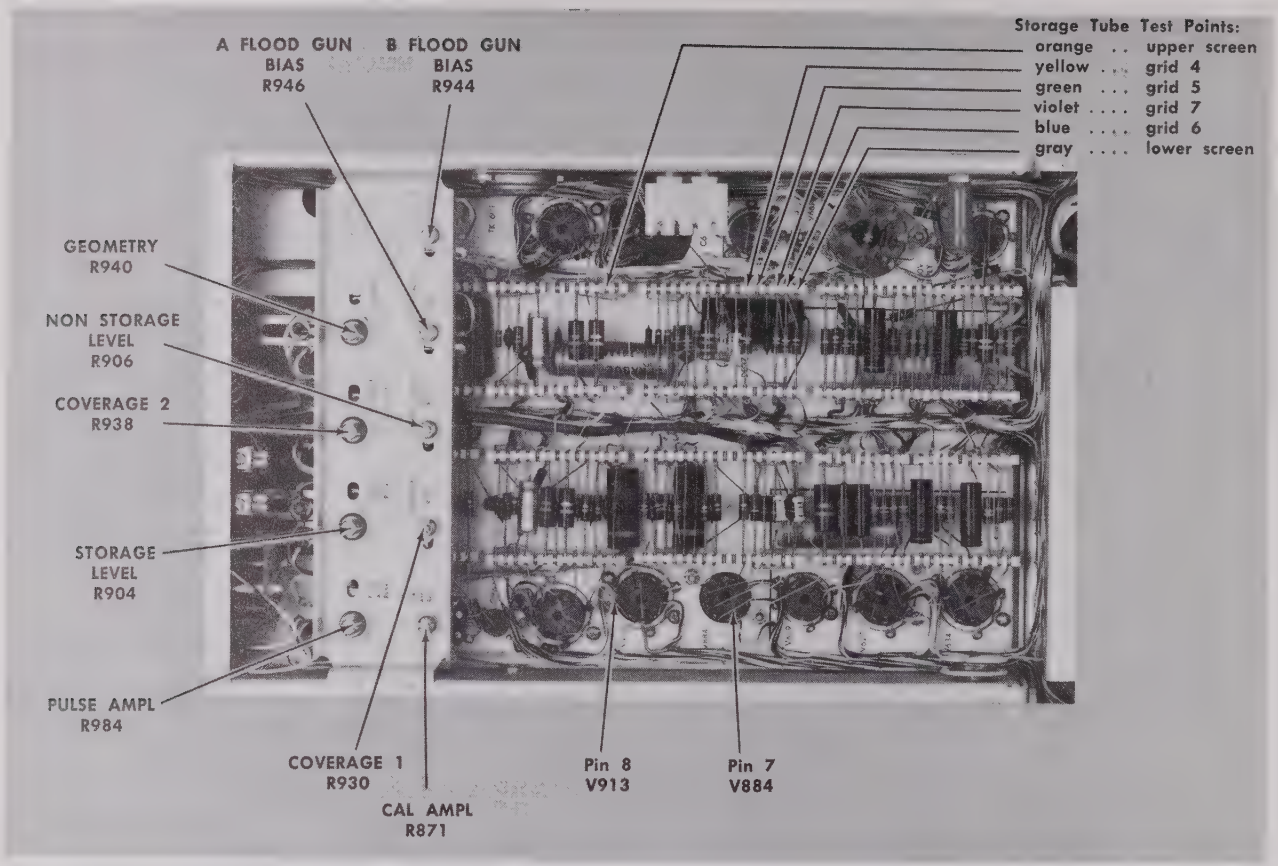


Fig. 5-5. Storage circuit and calibrator test points and adjustments on bottom of Type RM564.

f. Adjust the test oscilloscope intensity and focus.

g. Measure the Calibrator 10% to 90% risetime with the test oscilloscope. Risetime should be 5 μsec or less.

18. Check Calibrator Attenuator

a. Reset the following test oscilloscope controls:

Sweep rate	10 msec/div
Deflection factor	2 volts/div
Variable (Volts/Div)	Calibrated

b. With the test probe connected to the Type RM564 CAL OUT, decrease the test oscilloscope intensity to normal and focus the display.

c. Set the baseline of the Calibrator waveform 1 major division above the bottom graticule line. (There should now be 5 divisions of deflection. If your test oscilloscope has a 4-division crt screen, increase the deflection factor to 5 volts/div.)

d. Check the Calibrator attenuator accuracy with the test oscilloscope, from 100 V through 100 mV, as outlined in Table 5-2. Accuracy on all steps should be within 3% (plus the test oscilloscope attenuator tolerance).

TABLE 5-2

Calibrator Attenuator Check

CALIBRATOR	Test Volts/Div	Deflection (div.)
100 V	20	5
10 V	2	5
1 V	.2	5
100 mV	.05	2

If desired, the Calibrator attenuator steps, including those below 100 mV, can be checked with a sensitive non-loading voltmeter (such as a John Fluke 800). To make this check, set the CALIBRATOR switch to OFF and measure the voltages along the divider, R885 through R892. Accuracy should be within 3%.

e. Set the Type RM564 CALIBRATOR switch to 1 V (.1 V INTO 50 Ω).

f. Install a 50-ohm termination on the Type RM564 CAL OUT connector.

g. Set the test oscilloscope deflection factor to .02 volts/div.

h. Remove the 10X probe from the test oscilloscope input and connect a 50-ohm coaxial cable from the 50-ohm termination on the Type RM564 CAL OUT connector to the test oscilloscope input connector.

i. Check the output amplitude with the test oscilloscope. When terminated in 50 ohms, the amplitude should be 0.1 volt with the CALIBRATOR switch at the 1 V position. Accuracy should be within 3% (plus the termination tolerance and test oscilloscope tolerance).

j. Remove the termination and disconnect the cable.

k. Set the CALIBRATOR switch to OFF.

STORAGE CIRCUIT

19. Adjust Geometry

a. Reset the following controls:

Time-base Mode	Normal
Time/Div	.1 msec
Triggering	+ Internal, free run

b. Connect the DC voltmeter between the geometry neck pin (ORANGE) and ground.

c. Adjust R940 (GEOMETRY) for a meter reading of +180 volts. The location of R940 is shown in Fig. 5-5.

d. Disconnect the meter.

e. Adjust the INTENSITY control for a trace of normal brightness.

f. Center the trace horizontally and position it to the top of the graticule.

g. Check the geometry adjustment by observing the alignment and curvature of the trace.

h. Position the trace to the bottom of the graticule.

i. Check the geometry at the bottom of the crt screen.

j. If there is more than 2 mm deviation (alignment plus curvature) over the 10 divisions, readjust R940 for minimum deviation.

k. Turn the INTENSITY control fully counterclockwise.

20. Adjust Flood-Gun Bias

a. Fade the screens positive ("write" the screens fully). The following procedure is suggested:

(1) Reset the following controls:

FOCUS	Counterclockwise
Amplifier Position	Counterclockwise
Time-base Level	Free Run
Time/Div	.5 msec
INTENSITY	Centered
Upper DISPLAY	STORE
Lower DISPLAY	STORE

(2) Sweep the free-running defocused trace over the entire area of the storage screens by turning the amplifier unit Position control slowly clockwise. If either edge of the screens remains "unwritten" (not stored), reposition the trace horizontally with the time-base unit Position control.

(3) Leave the amplifier unit Position control either fully clockwise or fully countercockwise to position the trace off the storage area.

b. Turn R944 (B FLOOD GUN BIAS) fully clockwise, then turn it counterclockwise until the screens are uniformly bright. See Fig. 5-5 for the location of R944. Do not adjust the control counterclockwise any farther than necessary.

c. Adjust R946 (A FLOOD GUN BIAS) in the same manner as R944.

21. Adjust Collimation Electrode Voltages

a. With the screens faded positive, turn R938 (COVERAGE 2) fully counterclockwise, then clockwise until the screens brighten appreciably.

b. Turn the control slightly counterclockwise again to the point where the screens just began to brighten. The entire area of the screens should display a uniform light level.

c. Turn R930 (COVERAGE 1) fully counterclockwise, then clockwise until the background light level is uniform out to the edges of the illuminated screens. Do not adjust R930 farther than necessary.

d. Press both DISPLAY switches to ERASE, then fade the screens positive again (as in step 20a). Recheck the coverage at the edges of the screens.

e. Remove the screens from the fade-positive state by pressing both DISPLAY switches to ERASE, then releasing them to STORE position.

f. Check the screens for any apparent reflections near the edges. If reflections appear, turn R930 clockwise slightly and check step 21d again.

g. If R390 cannot be satisfactorily adjusted for edge uniformity (while faded positive) without causing reflections on the screen (in storage mode), readjust R939 (COVERAGE 2) as described in steps 21a and 21b, then adjust R930 again.

h. Set the Lower DISPLAY switch to NON STORE.

i. Press the Upper DISPLAY switch to ERASE and check for uniform flooding of the upper storage screen during the erase pulse.

j. Set the Upper DISPLAY switch to NON STORE.

k. Press the Lower DISPLAY switch to ERASE and check for uniform flooding of the lower storage screen during the erase pulse.

l. Set the Lower DISPLAY switch to NON STORE.

22. Determine Standard Intensity Setting

This step establishes the INTENSITY control setting required to produce 60 μamps of writing-beam current, to be used in steps 23 through 27.

a. Turn off the power switch (SCALE ILLUM) to make the following connection.

b. Carefully disconnect the clip lead from the left horizontal deflection-plate neck pin (RED lead).

c. Connect one lead of the ammeter (60 μamp scale) to the neck pin and the other meter lead to the deflection-plate lead. Be careful not to bend the crt neck pin.

d. Insulate the deflection-plate lead from chassis ground.

e. Reset the following controls:

INTENSITY	Counterclockwise
FOCUS	Centered
Amplifier Position	Centered
Time-base Position	Counterclockwise
Time/Div	External Input
Upper DISPLAY	NON STORE
Lower DISPLAY	NON STORE

f. Turn on the Type RM564.

g. After about 1 minute of warm up, adjust the INTENSITY control to produce 60 μamps of beam current in the left horizontal deflection plate, as indicated on the ammeter.

h. Adjust the amplifier unit Position control for a maximum reading on the meter, then readjust the INTENSITY control if necessary for 60 μamps of beam current. DO NOT move the spot onto the crt screen with the time-base unit Position control.

i. Note and record the setting of the INTENSITY control knob.

CAUTION

During subsequent steps, be sure the time-base Mode switch remains at Single Sweep position whenever the INTENSITY control is set at this high level.

j. Turn off the Type RM564, disconnect the ammeter and reconnect the deflection-plate lead to the crt neck pin.

k. Reset the following controls:

INTENSITY	Counterclockwise
Time-base Mode	Single Sweep
Time-base Position	Centered
Time/Div	.1 msec

l. Turn on the Type RM564 and allow 2 or 3 minutes for warm up.

23. Adjust Storage Level

a. Connect the dc voltmeter (300-volt scale) between ground and pin 8 of V913 (lower storage-target backplate). See Fig. 5-5.

b. Set the INTENSITY control to the 60-μamp position determined in step 22.

c. Apply several single sweeps of the trace, center the trace on the crt screen and adjust the FOCUS and ASTIG controls for a well-defined trace.

d. Turn R940 (STORAGE LEVEL) fully counterclockwise.

e. Set both DISPLAY switches to STORE.

f. Advance R904 slowly in the clockwise direction until some portions of the screens begin to have a slight background glow.

g. Press both DISPLAY switches to ERASE, then release them to STORE position.

h. After about 15 seconds, apply single sweeps at several vertical positions on the crt screen and check the display for storage. The traces should not store well at this setting.

i. Note the voltage reading on the meter.

j. Advance R904 clockwise just enough to produce a 5-volt change on the meter.

k. Erase the screens again.

l. After 15 seconds, observe another series of single sweeps at several vertical positions on the screen.

m. Continue advancing R904 in 5-volt increments (erasing and waiting 15 seconds at each setting) until the single

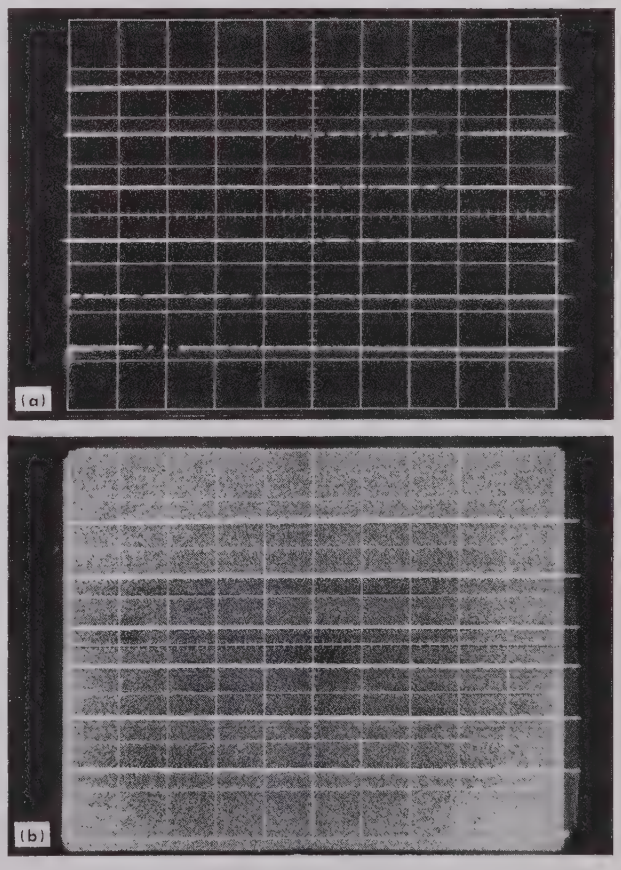


Fig. 5-6. Storage level adjustment: (a) Retention threshold; (b) fade-positive threshold.

sweeps will store anywhere on the storage screens with no breaks in the traces. (Storage does not occur on the screen-separation line.)

n. Now begin decreasing the voltage in 1-volt increments, by adjusting R904 slightly counterclockwise, until the single sweeps will store with breaks no greater than about 1/8th inch (see Fig. 5-6a).

o. Note and record the voltage reading on the meter. This is the retention threshold.

p. Advance R904 again in 5-volt increments (erasing and waiting 15 seconds) until the single-sweep traces start to spread into the background (see Fig. 5-6b).

q. Note and record this meter voltage as the fade-positive threshold.

r. R904 may be set for a meter reading anywhere in the "stable range" (voltage range between the retention threshold and the fade-positive threshold):

For the "normal" storage level adjustment, set R904 at the middle of the stable range;

For an improvement in contrast ratio (at the expense of writing rate), set R904 nearer the retention threshold;

For an improvement in writing rate (at the expense of contrast ratio), set R904 nearer the fade-positive threshold.

s. Disconnect the voltmeter.

24. Adjust Non Storage Level

a. Set one DISPLAY switch to NON STORE.

b. Press the second DISPLAY switch to ERASE, then relase it.

c. Adjust R906 (NON STORAGE LEVEL) for the best division between the two screens, with no background glow on the non-stored screen (see Fig. 5-7).

d. Move the (second) DISPLAY switch to NON STORE. The screen must become dark quickly and completely without disturbing the other storage screen.

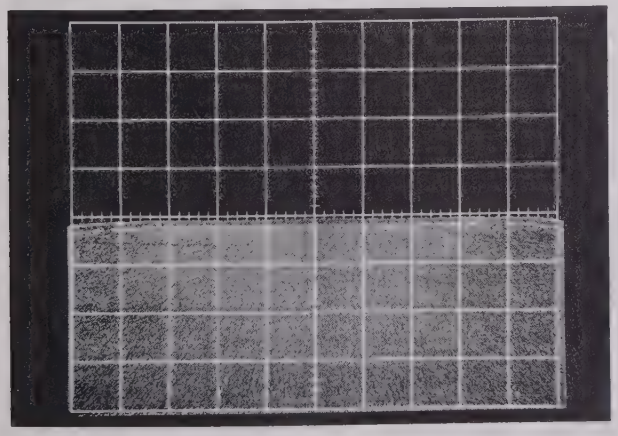


Fig. 5-7. Non storage level adjustment, with Upper DISPLAY switch at NON STORE and Lower DISPLAY switch at STORE.

e. Press both DISPLAY switches to ERASE, then recheck the adjustment of R906 by repeating steps 24a, b and d.

25. Check Writing Speed

a. Reset the following controls:

Upper DISPLAY	NON STORE
Lower DISPLAY	NON STORE
Amplifier Volts/Div	2
Time-base Time/Div	.1 msec
Triggering	Free Run

b. Set the test oscilloscope controls:

Horiz. Mode	Normal
Sweep Rate	5 μsec/div
Triggering	+ Internal
Vertical Mode	Normal (Channel 1)
Deflection Factor	2 volts/div
Input Coupling	AC

c. Set the Type RM564 INTENSITY control for a beam current of 60 μamps (determined in step 22).

d. Apply several single sweeps of the trace and adjust the FOCUS and ASTIG controls for a well-defined trace.

e. Press both DISPLAY switches to ERASE, then release them.

f. Alternately store and erase single sweeps of the trace while continually increasing the sweep rate in small steps. With the time-base unit Time/Div switch and Variable control, adjust for the sweep rate that will permit the trace to store anywhere on the center 6-cm by 8-cm area of the screens with breaks in the trace not exceeding 1 mm. This is the maximum writing speed of the crt. (Do not charge the settings of the Time/Div or Variable controls until the sweep rate has been measured.)

g. The following procedure is suggested for determining the sweep speed of the Type RM564 at the maximum writing speed:

(1) Reset only the following controls:

INTENSITY	Counterclockwise
Upper DISPLAY	NON STORE
Lower DISPLAY	NON STORE
Time-base Mode	Normal

(2) Apply the output of the Type 105 Square-Wave Generator to the vertical input of the amplifier unit.

(3) Adjust the Type RM564 INTENSITY control for normal brightness.

(4) Adjust the output amplitude of the Type 105 to produce approximately 2 major divisions of deflection.

(5) Trigger the square-wave display.

(6) Focus the display.

(7) Adjust the Type 105 output frequency to display exactly 1 cycle per division on the Type RM564 crt screen. (now do not change the Type 105 output frequency.)

(8) Turn the INTENSITY control fully counterclockwise.

(9) Move the square-wave signal from the amplifier input to the vertical input of the test oscilloscope.

(10) Trigger the test oscilloscope display.

(11) With the test oscilloscope, measure the time for one complete cycle of the square wave. This is the sweep time per division at the maximum writing speed of the storage tube.

h. Determine the writing speed of the Type RM564, in divisions (cm)/msec, by calculating the reciprocal of the sweep time/division. For example:

If: Sweep time/div = 33 μsec,

Then: Writing speed = 1 div/33 μsec

= 30 div (cm)/msec.

The writing speed can be increased (at the expense of contrast ratio) by raising the storage level adjustment (see step 23).

26. Adjust Enhancement Pulse Amplitude

a. Reset the following controls:

Upper DISPLAY	NON STORE
Lower DISPLAY	NON STORE
Time-base Mode	Single Sweep
Time/Div	.1 msec
Variable	Calibrated
Triggering	Free run

b. Set the INTENSITY control for a beam current of 60 μamps (determined in step 22).

c. Apply several single sweeps of the trace and adjust the FOCUS and ASTIG controls for a well-defined trace.

d. Press both DISPLAY switches to ERASE, then release to STORE.

e. Turn on (pull out) the WRITING RATE INCREASE switch and turn the control fully clockwise.

f. Set R984 (PULSE AMPL) fully counterclockwise.

g. Alternately store and erase single sweeps of the trace while adjusting R984 clockwise in small steps. After erasing each time, wait 10 seconds before storing another single sweep. Continue adjusting R984 until the single-sweep pulses cause portions of the storage screens to start fading positive and the trace begins to spread into the background (see Fig. 5-8).

h. Check the adjustment by applying another single sweep without erasing first. Most of the storage screen area should fade positive, making the screens unuseable.

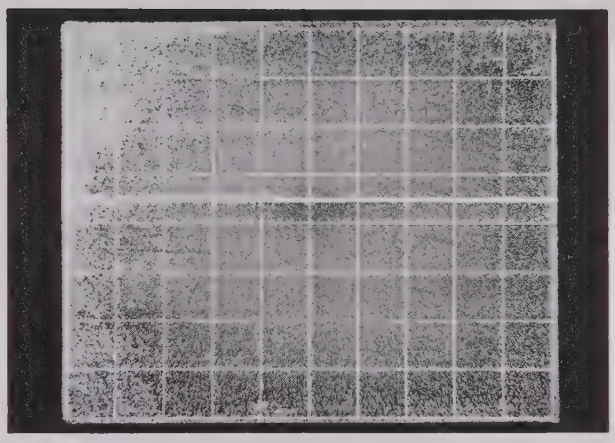


Fig. 5-8. Enhancement pulse amplitude adjustment, with WRITING RATE INCREASE control set to maximum.

27. Check Writing Speed Increase

a. Leave the WRITING RATE INCREASE control turned on (pulled out) and turned fully clockwise.

b. Set both DISPLAY switches to ERASE, then release to STORE.

c. Check the writing speed of the storage tube as in step 25c through 25h, but with the WRITING RATE INCREASE turned on fully. Use only one single sweep of the crt screen for each display. When determining the sweep rate, turn off (push in) the WRITING RATE INCREASE switch.

d. Determine the increase in writing speed. This should be typically 10:1 for a T5640-200 crt, or 5:1 for a T5640-201 crt.

28. Check Locate Operation

a. Reset the following controls:

INTENSITY	Counterclockwise
Time/Div	.1 msec
Variable	Calibrated
Triggering	Free run

b. Adjust the INTENSITY control to display a very dim trace.

c. Position the free-running trace so that it starts exactly at the left edge of the graticule.

d. Set the time-base Mode switch to Single Sweep.

e. Press the LOCATE button. A spot should appear off-screen at the left edge of the graticule at the level of the trace. The spot should not store in the Locate Zone. Note that the amplifier unit Position control moves the spot vertically.

f. Release the button.

29. Check Integrate Function

a. Reset the following controls:

Upper DISPLAY	STORE
Lower DISPLAY	STORE
Time/Div	5 μsec

b. Press both DISPLAY switches to ERASE, then release to STORE.

c. Set the INTENSITY control to the point that will allow single sweeps to be seen, but will not allow them to store.

d. Press the DISPLAY switches to ERASE, then release them to STORE.

e. Press the INTEGRATE button and hold it.

f. Actuate approximately 5 single sweeps of the trace, without changing the setting of either Position control.

g. Release the INTEGRATE button. A stored trace should be present on the screen.

h. Turn the INTENSITY control fully counterclockwise and set the DISPLAY switch to NON STORE.

30. Check Remote Erase

a. Set the Time/div switch to .1 msec.

b. Position the trace level to the upper storage screen. (If the LOCATE button is used, be sure to decrease the intensity.)

c. Store a single sweep of the trace.

d. Position the trace to the lower storage screen.

e. Store a single sweep of the trace.

f. Insert a 2-inch section of bare 22-gauge wire into pin D of the rear-panel remote erase jack, and a second 2-inch section of wire into pin A of the jack.

g. While watching the upper storage screen, touch the two wires together. The stored trace on the upper screen should be erased.

h. Move the second wire from pin A to pin B.

i. While watching the lower storage screen, touch the two wires together. The stored trace on the lower screen should be erased.

j. Remove the two wires.

k. Turn the INTENSITY control fully counterclockwise and set the Time-base Mode switch to Normal.

31. Check Stored Brightness

Omit this step and the following step if storage tube brightness data is not required.

a. Fade the screens positive as in step 20.

b. Place the light sensor of the photometer against the graticule in front of the storage tube.

c. Measure and record the brightness at six points on the storage screens—three on the upper screen and three on the lower screen. Initial minimum brightness is 6 foot-lamberts for a T5640-200 crt or 2 foot-lamberts for a T5640-201 crt, but decreases with the age of the tube (see Fig. 1-1).

32. Check Contrast Ratio

a. Press both DISPLAY switches to ERASE position twice, then release them.

b. Wait 15 seconds, then measure and record the background brightness of the storage screens at the same six points that were measured for stored brightness.

c. Compare the stored brightness to the background brightness at each point. The stored-to-background contrast ratio should be at least 2:1.

d. Set both DISPLAY switches to NON STORE.

NOTES

SECTION 6
PARTS LIST AND SCHEMATICS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

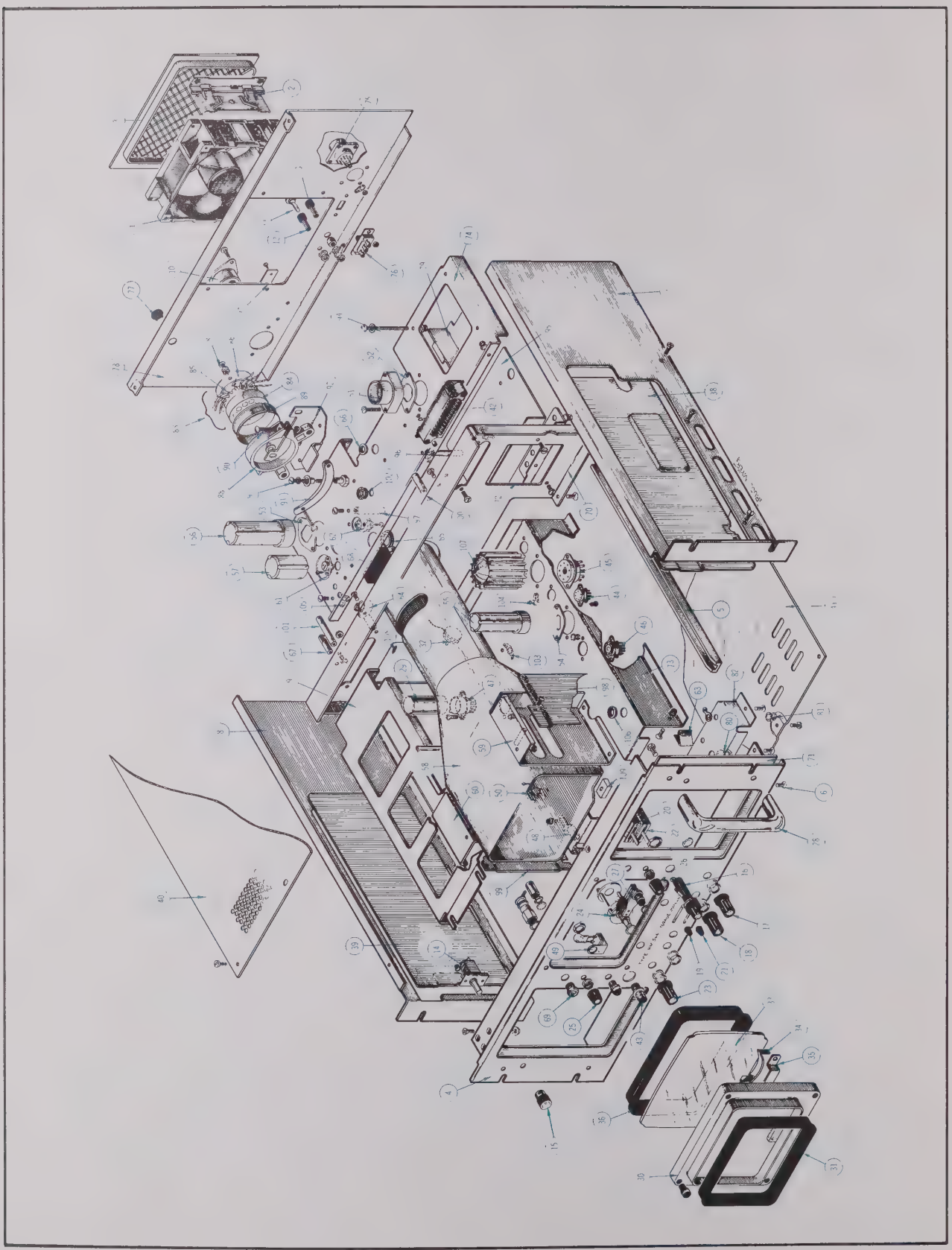
ABBREVIATIONS AND SYMBOLS

a or amp	amperes
BHS	binding head steel
C	carbon
cer	ceramic
cm	centimeter
comp	composition
cps	cycles per second
crt	cathode-ray tube
CSK	counter sunk
dia	diameter
div	division
EMC	electrolytic, metal cased
EMT	electroyltic, metal tubular
ext	external
f	farad
F & I	focus and intensity
FHS	flat head steel
Fil HS	fillister head steel
g or G	giga, or 10^9
Ge	germanium
GMV	guaranteed minimum value
h	henry
hex	hexagonal
HHS	hex head steel
HSS	hex socket steel
HV	high voltage
ID	inside diameter
incd	incandescent
int	internal
k or K	kilohms or kilo (10^3)
kc	kilocycle
m	milli, or 10^{-3}
mc	megacycle
mm	millimeter
meg or M	megohms or mega (10^6)
met.	metal
μ	micro, or 10^{-6}
n	nano, or 10^{-9}
Ω	ohm
OD	outside diameter
OHS	oval head steel
p	pico, or 10^{-12}
PHS	pan head steel
piv	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
Prec	precision
PT	paper tubular
PTM	paper or plastic, tubular, molded
RHS	round head steel
rms	root mean square
sec	second
Si	silicon
S/N	serial number
t or T	tera, or 10^{12}
TD	toroid
THS	truss head steel
tub.	tubular
v or V	volt
Var	variable
w	watt
w/	with
w/o	without
WW	wire-wound

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

EXPLODED VIEW



EXPLODED VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	119-0031-00			1	FAN
	- - - - - -			-	Mounting Hardware: (not included)
2	351-0046-00			2	GUIDE, muffin fan
	- - - - - -			-	Mounting Hardware For Each: (not included)
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
	211-0538-00			2	SCREW, 6-32 x 5/16 inch FHS 100° CSK
3	378-0761-00			1	SCREEN, grille
4	333-0807-00			1	PANEL, front
5	351-0047-00			2	GUIDE, rail track
	- - - - - -			-	Mounting Hardware For Each: (not included)
6	210-0407-00			1	NUT, hex, 6-32 x 1/4 inch
	211-0541-00			1	SCREW, 6-32 x 1/4 inch FHS 100° CSK
	211-0559-00			1	SCREW, 6-32 x 3/8 inch FHS 100° CSK
7	387-0898-00			1	PLATE, side right
	- - - - - -			-	Mounting Hardware: (not included)
	210-0458-00			7	NUT, keps, 8-32 x 11/32 inch
	212-0023-00			2	SCREW, 8-32 x 3/8 inch BHS
	212-0040-00			5	SCREW, 8-32 x 5/16 inch FHS
8	387-0447-00			1	PLATE, side left
	- - - - - -			-	Mounting Hardware: (not included)
	210-0458-00			7	NUT, keps, 8-32 x 11/32 inch
	212-0023-00			2	SCREW, 8-32 x 3/8 inch BHS
	212-0040-00			5	SCREW, 8-32 x 5/16 inch FHS
9	406-0716-00			2	BRACKET, plug-in
	- - - - - -			-	Mounting Hardware For Each: (not included)
	210-0458-00			4	NUT, keps, 8-32 x 11/32 inch
	212-0023-00			2	SCREW, 8-32 x 3/8 inch BHS
	212-0070-00			2	SCREW, 8-32 x 5/16 inch FHS
10	131-0150-00	101	2679	1	CONNECTOR, 3 wire
	131-0150-01	2680		1	CONNECTOR, 3 wire
	- - - - - -			-	Mounting Hardware: (not included)
	213-0104-00			2	SCREW, 6-32 x 3/8 inch Truss head, thread forming
11	134-0012-00			1	PLUG, banana twin male
12	136-0140-00			1	SOCKET, banana jack, charcoal
	- - - - - -			-	Mounting Hardware: (not included)
	210-0046-00			1	LOCKWASHER, internal 1/4 inch
	210-0465-00			1	NUT, hex, 1/4-32 x 3/8 inch
13	136-0139-00			1	SOCKET, banana jack, red
	- - - - - -			-	Mounting Hardware: (not included)
	210-0223-00			1	LUG, solder 1/4 inch
	210-0465-00			2	NUT, hex, 1/4-32 x 3/8 inch
	210-0898-00			1	WASHER, red banana jack
14	214-0424-00			1	FASTENER, right
	214-0425-00			1	FASTENER, left
	- - - - - -			-	Mounting Hardware For Each: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
15	366-0109-00			2	KNOB, plug-in securing
	- - - - - -			-	Includes:
	213-0005-00			1	SCREW, set, 8-32 x 1/8 inch HSS

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
16	352-0014-00			1	HOLDER, fuse with hardware
17	366-0220-00			1	KNOB, SCALE ILLUM, charcoal
	- - - - - -			-	Includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch HSS
	- - - - - -			-	Mounting Hardware For Pot: (not included)
	210-0013-00			1	LOCKWASHER, internal 3/8 x 11/16 inch
	210-0590-00			1	NUT, hex, 3/8-32 x 7/16 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
18	366-0220-00			1	KNOB, WRITING RATE, charcoal
	- - - - - -			-	Includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch HSS
	- - - - - -			-	Mounting Hardware For Pot: (not included)
	210-0013-00			1	LOCKWASHER, internal 3/8 x 11/16 inch
	210-0590-00			1	NUT, hex, 3/8-32 x 7/16 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
19	366-0215-00	101	889	1	KNOB, DISPLAY UPPER, charcoal
	366-0215-01	890		1	KNOB, DISPLAY UPPER, charcoal
20	260-0609-00			1	SWITCH, DISPLAY UPPER, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
21	366-0215-00	101	889	1	KNOB, DISPLAY LOWER, charcoal
	366-0215-01	890		1	KNOB, DISPLAY LOWER, charcoal
22	260-0609-00			1	SWITCH, DISPLAY LOWER, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT,hex, 4-40 x 3/16 inch
23	366-0220-00			1	KNOB, CALIBRATOR, charcoal
	- - - - - -			-	Includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch HSS
24	262-0652-00			1	SWITCH, CALIBRATOR, wired
	- - - - - -			-	Includes:
	260-0394-00			1	SWITCH, CALIBRATOR, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0013-00			1	LOCKWASHER, internal 3/8 x 11/16 inch
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
25	366-0270-00			1	KNOB, FOCUS, charcoal
	- - - - - -			-	Includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch HSS
	- - - - - -			-	Mounting Hardware For Pot: (not included)
	210-0046-00			1	LOCKWASHER, internal .400 OD x .261 inch ID
	210-0583-00			1	NUT, hex, 1/4-32 x 5/16 inch
	200-0608-00	X2010		1	COVER, variable resistor
26	366-0270-00			1	KNOB, INTENSITY, charcoal
	- - - - - -			-	Includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch HSS
	- - - - - -			-	Mounting Hardware For Pot: (not included)
	210-0046-00			1	LOCKWASHER, internal .400 OD x .261 inch ID
	210-0583-00			1	NUT, hex, 1/4-32 x 5/16 inch
	200-0608-00	X2010		1	COVER, variable resistor

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EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
27	260-0602-00	101	329	1	SWITCH, INTEGRATE, unwired
	260-0645-00	330		1	SWITCH, INTEGRATE, unwired
	260-0602-00	101	329	1	SWITCH, LOCATE, unwired
	260-0645-00	330		1	SWITCH, LOCATE, unwired
	- - - - - -			-	Mounting Hardware For Each: (not included)
	210-0012-00			1	LOCKWASHER, internal $\frac{3}{8} \times \frac{1}{2}$ inch
	210-0413-00			1	NUT, hex, $\frac{3}{8}$-32 x $\frac{1}{2}$ inch
	210-0840-00			1	WASHER, .390 ID x $\frac{9}{16}$ inch OD
28	367-0032-00			2	HANDLE, $4\frac{9}{16}$ inch
	- - - - - -			-	Mounting Hardware For each: (not included)
	213-0090-00			2	SCREW, 10-32 x $\frac{1}{2}$ inch Hex
29	337-0008-00			1	SHIELD, tube $1\frac{1}{32}$ inch ID with spring
30	200-0426-00			1	COVER, trim and graticule ass'y.
	- - - - - -			-	Includes:
31	101-0006-00			1	TRIM, graticule cover
	- - - - - -			-	Mounting Hardware: (not included)
	210-0571-00			4	NUT, 10-32 x $\frac{3}{8}$ inch knurled
32	214-0210-00			1	SPOOL, solder ass'y with solder
	- - - - - -			-	Mounting Hardware: (not included)
	361-0007-00			1	SPACER, nylon
33	331-0097-00			1	GRATICULE, plexiglass, $4^{11}\frac{1}{16} \times 4\frac{1}{4}$ inch
34	337-0540-00			1	SHIELD, reflector
35	352-0049-00			1	HOLDER, reflector shield
36	354-0181-00			1	RING, CRT shockmount, black neoprene
37	334-0649-00			1	TAG, voltage rating
	- - - - - -			-	Mounting Hardware: (not included)
	213-0088-00			2	SCREW, thread forming #4 x $\frac{1}{4}$ inch PHS
38	387-0449-00			1	PLATE, side cover, right
	- - - - - -			-	Mounting Hardware: (not included)
	210-0457-00			1	NUT, keps, 6-32 x $\frac{5}{16}$ inch
	211-0507-00			4	SCREW, , 6-32 x $\frac{5}{16}$ inch BHS
	211-0538-00			1	SCREW, 6-32 x $\frac{5}{16}$ inch FHS 100° CSK
39	387-0450-00			1	PLATE, side cover, left
	- - - - - -			-	Mounting Hardware: (not included)
	210-0457-00			1	NUT, keps, 6-32 x $\frac{5}{16}$ inch
	211-0507-00			4	SCREW, 6-32 x $\frac{5}{16}$ inch BHS
	211-0538-00			1	SCREW, 6-32 x $\frac{5}{16}$ inch FHS 100° CSK
40	387-0452-00			1	PLATE, dust cover, top
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			6	SCREW, 6-32 x $\frac{5}{16}$ inch BHS
41	387-0895-00			1	PLATE, dust cover, bottom
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			6	SCREW, 6-32 x $\frac{5}{16}$ inch BHS
42	131-0148-00			2	CONNECTOR, 24 pin
	- - - - - -			-	Mounting Hardware For Each: (not included)
	166-0029-00			2	TUBE, spacer $\frac{3}{16}$ inch
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x $\frac{3}{16}$ inch
	211-0014-00			2	SCREW, 4-40 x $\frac{1}{2}$ inch BHS

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
43	131-0274-00			1	CONNECTOR, chassis BNC
44	136-0008-00			3	SOCKET, STM7G
	- - - - - -			-	Mounting Hardware For each: (not included)
	213-0044-00			2	SCREW, thread cutting,5-32 x 3/16 inch Pan HS
45	136-0013-00			1	SOCKET, STM8
	- - - - - -			-	Mounting Hardware: (not included)
	210-0006-00			2	LOCKWASHER, internal #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
	211-0538-00			2	SCREW, 6-32 x 5/16 inch FHS 100° CSK
46	136-0015-00			5	SOCKET, STM9G
	- - - - - -			-	Mounting Hardware For Each: (not included)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch PHS
47	136-0022-00			1	SOCKET, STM9S
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	211-0033-00			2	SCREW, 4-40 x 5/16 inch Pan HS with lockwasher
48	136-0035-00			2	SOCKET, graticule light
	- - - - - -			-	Mounting Hardware for Each: (not included)
	210-0006-00			1	LOCKWASHER, internal #6
	210-0406-00			1	NUT, hex, 6-32 x 1/4 inch
	210-0803-00			1	WASHER, 6L x 3/8 inch
	211-0534-00			1	SCREW, 6-32 x 5/16 inch PHS with lockwasher
49	136-0047-00	101	2809	1	SOCKET, light with red jewel
	136-0079-00	2810		1	SOCKET, light with green jewel
50	136-0161-00	101	539	3	SOCKET, 3 pin transistor
	136-0181-00	540		3	SOCKET, 3 pin transistor
	- - - - - -			-	Mounting Hardware For Each: (not included)
	213-0113-00	101	539	2	SCREW, thread forming, 2-32 x 5/16 inch RHS
	354-0234-00	540		1	RING, locking, transistor socket
51	432-0048-00			3	BASE, delrin capacitor mtg. large
	- - - - - -			-	Mounting Hardware For Each: (not included)
	211-0532-00			2	SCREW, 6-32 x 3/4 inch Fil HS
52	386-0255-00			1	PLATE, metal large
53	386-0254-00			4	PLATE, fiber large
54	386-0252-00			1	PLATE, fiber small
55	200-0257-00			1	COVER, capacitor polyethylene 2 17/32 x 1 inch dia
56	200-0258-00			2	COVER, capacitor polyethylene 3 1/32 x 1.365 inch dia
57	200-0260-00			2	COVER, capacitor polyethylene 2 1/32 x 1.365 inch dia
58	337-0551-00			1	SHIELD, CRT
	- - - - - -			-	Mounting Hardware: (not included)
59	406-0846-00			1	BRACKET, CRT, shield, right
60	406-0847-00			1	BRACKET, CRT shield, left
	210-0006-00			4	LOCKWASHER, internal #6
	210-0406-00			4	NUT, hex, 6-32 x 1/4 inch
	210-0458-00			6	NUT, keps, 8-32 x 11/32 inch
	211-0507-00			4	SCREW, 6-32 x 5/16 inch BHS
	212-0004-00			4	SCREW, 8-32 x 5/16 inch BHS
	212-0070-00			2	SCREW, 8-32 x 5/16 inch FHS
	337-0692-00	X1720	2569	1	SHIELD, CRT extension sleeve
	337-0692-01	2570		1	SHIELD, CRT extension sleeve
	162-0592-00	X3047		1	INSULATION

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
61	136-0161-00	101	539	2	SOCKET, 3 pin transistor
	136-0181-00	540		2	SOCKET, 3 pin transistor
	- - - - - -			-	Mounting Hardware For Each: (not included)
	213-0113-00	101	539	2	SCREW, thread forming, 2-32 x 5/16 inch RHS
	354-0234-00	540		1	RING, locking, transistor socket
62	136-0015-00			2	SOCKET, STM9G
	- - - - - -			-	Mounting Hardware For Each: (not included)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch PHS
63	344-0095-00			2	CLIP, grounding
	- - - - - -			-	Mounting Hardware For Each: (not included)
	210-0006-00			1	LOCKWASHER, internal #6
	210-0407-00			1	NUT, hex, 6-32 x 1/4 inch
	211-0538-00			1	SCREW, 6-32 x 5/16 inch FHS 100° CSK
64	343-0003-00			2	CLAMP, cable 1/4 inch
	- - - - - -			-	Mounting Hardware For Each: (not included)
	210-0860-00			1	WASHER, D type
	211-0504-00			1	SCREW, 6-32 x 1/4 inch BHS
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
	385-0013-00			1	POST, nylon
65	348-0050-00			2	GROMMET, plastic, 3/4 inch
66	348-0056-00			1	GROMMET, delrin 3/8 inch
67	352-0015-00			2	HOLDER, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	211-0033-00			1	SCREW, 4-40 x 5/16 inch PHS
68	352-0031-00			1	HOLDER, fuse, single 3AG
	- - - - - -			-	Mounting Hardware: (not included)
	210-0006-00			1	LOCKWASHER, internal #6
	210-0407-00			1	NUT, hex, 6-32 x 1/4 inch
	211-0511-00			1	SCREW, 6-32 x 1/2 inch BHS
69	- - - - - -			-	Pot Mounting Hardware
	210-0012-00			1	LOCKWASHER, internal 3/8 x 1/2 inch
	210-0013-00			1	LOCKWASHER, internal 3/8 x 11/16 inch
	210-0207-00			1	LUG, solder, pot plain 3/8 inch
	210-0494-00			1	NUT, hex, alum 3/8-32 x 1/2 x 11/16 inch
	358-0010-00			1	BUSHING, alum 3/8-32 x 9/16 inch
70	387-0716-00			1	PLATE, bulkhead
	- - - - - -			-	Mounting Hardware: (not included)
	210-0458-00			10	NUT, keps, 8-32 x 11/32 inch
	212-0070-00			10	SCREW, 8-32 x 5/16 inch FHS
71	387-0896-00			1	PLATE, sub panel, front
72	407-0014-00			1	BRACKET, pot mounting
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch
73	441-0539-00			1	CHASSIS, front
	- - - - - -			-	Mounting Hardware: (not included)
	210-0458-00			2	NUT, keps, 8-32 x 11/32 inch
	212-0004-00			6	SCREW, 8-32 x 5/16 inch BHS
	212-0070-00			2	SCREW, 8-32 x 5/16 inch FHS

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
74	441-0540-00			1	CHASSIS, rear
	- - - - - -			-	Mounting Hardware: (not included)
	212-0004-00			8	SCREW, 8 - 32 x 5/16 inch BHS
	212-0070-00			4	SCREW, 4.40 x 5/16 inch PHB
75	136-0089-00			1	SOCKET, 9 pin
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			3	LOCKWASHER, internal #4
	210-0406-00			4	NUT, hex, 4-40 x 3/16 inch
	210-0201-00			1	LUG, solder SE4
	211-0011-00			4	SCREW, 4-40 x 1/4 inch BHS
76	260-0449-00			1	SWITCH, CRT CATHODE SELECTOR, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	211-0008-00			2	SCREW, 4-40 x 1/4 inch BHS
77	134-0067-00			2	PLUG, D hole, nylon grey
78	387-0937-00			1	PLATE, rear
	- - - - - -			-	Mounting Hardware: (not included)
	210-0458-00			4	NUT, keps, 8-32 x 11/32 inch
	212-0004-00			4	SCREW, 8-32 x 5/16 inch BHS
79	406-0881-00			1	BRACKET, transformer strip mounting
80	- - - - - -			-	Pot Mounting Hardware
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
81	- - - - - -			-	Mini Pot Mounting Hardware
	210-0223-00			1	LUG, solder 1/4 inch
	210-0583-00			1	NUT, hex, 1/4-32 x 5/16 inch
	210-0940-00			1	WASHER, 1/4 ID x 3/8 inch OD
82	406-0991-00			1	BRACKET, pot mounting
	- - - - - -			-	Mounting Hardware: (not included)
	211-0538-00			2	SCREW, 8-32 x 5/16 inch BHS
83	136-0189-00			1	SOCKET, CRT
	- - - - - -			-	Includes
84	136-0117-00			1	SOCKET, raw
	131-0178-00			13	CONNECTOR, CRT socket, Cable end
85	387-0393-00			1	PLATE, nylon CRT socket
86	337-0456-00			1	SHIELD, CRT socket
87	210-0849-00			2	WASHER, fiber #4
	210-0850-00			2	WASHER, #2 flat
	213-0116-00			2	SCREW, 2-32 x 9/16 inch RHS
88	354-0212-00			1	RING, CRT clamping assy.
	- - - - - -			-	Includes:
	354-0211-00			1	RING, CRT clamping
89	124-0160-00			1	STRIP, liner CRT clamp
90	211-0560-00	101	1719	1	SCREW, 6-32 x 1 inch RHS
	211-0529-00	1720		1	SCREW, 6-32 x 1 1/4 inches, PHS
	210-0407-00			1	NUT, hex, 6-32 x 1/4 inch
91	214-0207-00			1	NUT, adjusting, securing
	- - - - - -			-	Mounting Hardware: (not included)
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
	210-0949-00			2	WASHER, 9/64 ID x 1/2 inch OD
	211-0517-00			2	SCREW, 6-32 x 1 inch BHS
	124-0173-00	X1720		1	STRIP, ground, CRT shield

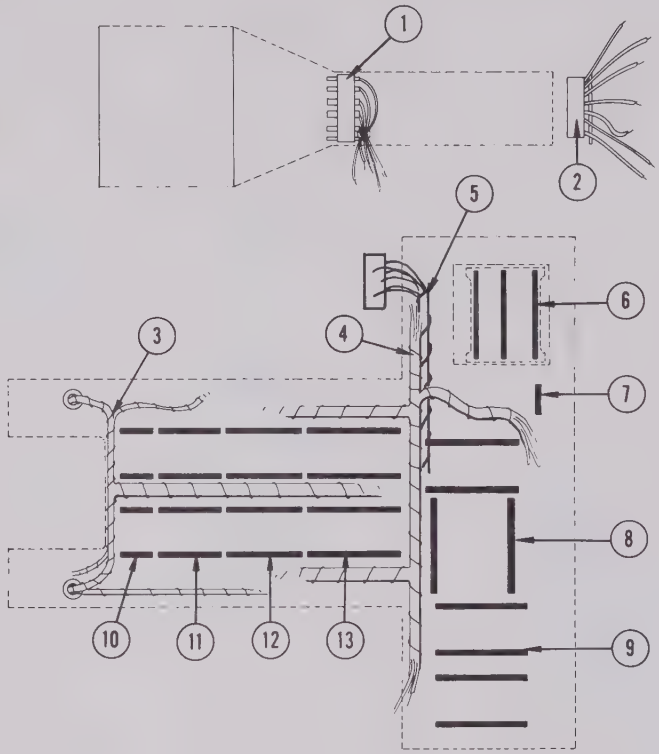
EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
92	406-0988-00			1	BRACKET, CRT mounting
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch BHS
93	- - - - - -			-	Resistor Mounting Hardware
	210-0462-00			1	NUT, hex, 8-32 x 1/2 inch
	210-0809-00			1	WASHER, centering 25 watt
	212-0004-00			1	SCREW, 8-32 x 5/16 inch BHS
	212-0037-00			1	SCREW, 8-32 x 1 3/4 inch Fil HS
94	- - - - - -			-	Transformer Mounting Hardware
	210-0564-00			4	NUT, hex, 10-32 x 3/8 inch
	210-0812-00			4	WASHER, fiber #10
	212-0522-00			4	SCREW, 10-32 x 2 1/2 inch Hex HS
95	337-0534-00			1	SHIELD, high voltage power
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			3	SCREW, 6-32 x 5/16 inch BHS
96	166-0099-00			1	TUBE, spacing
	- - - - - -			-	Mounting Hardware: (not included)
	210-0202-00			1	LUG, solder, SE6
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
97	385-0060-00			2	ROD, nylon, 5/16 x 1 3/4 inch
	- - - - - -			-	Mounting Hardware For Each: (not included)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
98	337-0535-00			1	SHIELD, F & I right
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch
99	337-0536-00			1	SHIELD, F & I left
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch
100	385-0135-00			1	ROD, delrin, 5/16 x 15/16 inch
	- - - - - -			-	Mounting Hardware: (not included)
	213-0041-00			1	SCREW, thread forming, 6-32 x 3/8 inch Truss HS phillips
101	385-0138-00			1	ROD, delrin, 5/16 x 1 9/16 inch
	- - - - - -			-	Mounting Hardware: (not included)
	213-0041-00			1	SCREW, thread forming, 6-32 x 3/8 inch Truss HS phillips
102	- - - - - -			-	Pot Mounting Hardware
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
103	210-0204-00			2	LUG, solder DE6
	- - - - - -			-	Mounting Hardware For Each: (not included)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch Pan HS phillips
104	210-0201-00			7	LUG, solder SE4
	- - - - - -			-	Mounting Hardware For Each: (not included)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch Pan HS phillips
105	210-0202-00			2	LUG, solder SE6
	- - - - - -			-	Mounting Hardware For Each: (not included)
	210-0407-00			1	NUT, hex, 6-32 x 1/4 inch
	211-0504-00			1	SCREW, 6-32 x 1/4 inch

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
106	348-0005-00			2	GROMMET, rubber 1/2 inch
107	337-0648-00			1	SHIELD, heat dissipating
108	344-0111-00	X510		2	CLIP, deflection lead
109	352-0044-00			1	HOLDER, coil form
	- - - - - -			-	mounting hardware: (not included w/holder)
	211-0011-00	101	549	1	SCREW, 4-40 x 5/16 inch BHS
	211-0110-00	550		1	SCREW, 4-40 x 5/16 inch PHB
	210-0004-00			1	LOCKWASHER, internal, #4
	210-0406-00			1	NUT, hex, 4-40 x 3/16 inch

CABLE HARNESS AND CERAMIC STRIP DETAIL



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	179-0867-00	100	299	1	CABLE HARNESS, 6 pin connector
	131-0363-00	300		1	CONNECTOR, wall board
2	179-0902-00			1	CABLE HARNESS, CRT socket
3	179-0891-00			1	CABLE HARNESS, front chassis
4	179-0855-00			1	CABLE HARNESS, rear chassis
5	179-0856-00			1	CABLE HARNESS, amphenol
6	124-0145-00			3	STRIP, ceramic 20 notches
	- - - - - -			-	Each Includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0009-00			2	SPACER, nylon
7	124-0087-00			1	STRIP, ceramic, 3/4 inch x 3 notches
	- - - - - -			-	Includes:
	355-0046-00			1	STUD, nylon
	- - - - - -			-	Mounting Hardware: (not included)
	361-0009-00			1	SPACER, nylon, molded
8	124-0091-00			3	STRIP, ceramic, 3/4 inch x 11 notches
	- - - - - -			-	Each Includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0039-00			2	SPACER, nylon, 1/4 diameter x 13/32 inch

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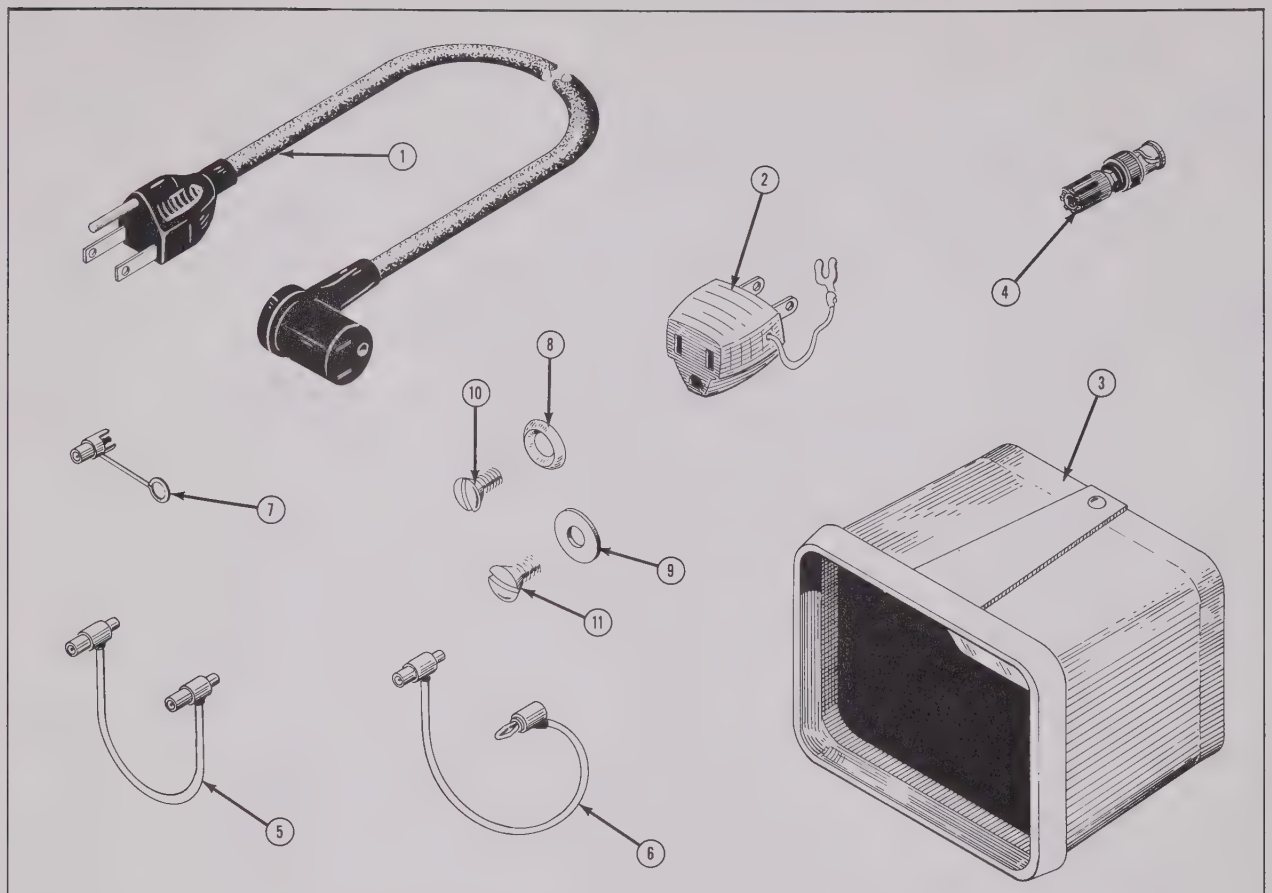
CABLE HARNESS AND CERAMIC STRIP DETAIL *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
9	124-0091-00			5	STRIP, ceramic, 3/4 inch x 11 notches
	- - - - - -			-	Each Includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0009-00			2	SPACER, nylon molded
10	124-0149-00			4	STRIP, ceramic, 7 notches
	- - - - - -			-	Each Includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0008-00			2	SPACER, nylon molded
11	124-0156-00			4	STRIP, ceramic, 13 notches
	- - - - - -			-	Each Includes
	355-0082-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0039-00			2	SPACER, nylon, 1/4 diameter x 13/32 inch
12	124-0155-00			4	STRIP, ceramic, 16 notches
	- - - - - -			-	Each Includes:
	355-0082-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0039-00			2	SPACER, nylon, 1/4 diameter x 13/32 inch
13	124-0154-00			4	STRIP, ceramic 20 notches
	- - - - - -			-	Each Includes:
	355-0082-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0039-00			2	SPACER, nylon, 1/4 diameter x 13/32 inch

STANDARD ACCESSORIES



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	161-0013-00	101	469	1	CORD, power
	161-0022-00	470	969	1	CORD, power
	161-0024-00	970	2299	1	CORD, power
	161-0024-01	2300		1	CORD, power
2	103-0013-00			1	ADAPTER, 3 to 2-wire
3	016-0039-00			1	VIEWER, polarized
4	103-0033-00	101	618X	2	ADAPTER, BNC to binding post
5	012-0031-00	101	618	1	CORD, patch
	012-0087-00	619		1	CORD, patch
6	012-0091-00	X619		1	CORD, patch
7	012-0092-00	X619		1	JACK, BNC-post
8	210-0833-00			4	WASHER, steel, #10 inishing
9	210-0917-00			4	WASHER, teflon
10	212-0512-00			4	SCREW, 10-32 x 1/2 OHS
11	212-0561-00			4	SCREW, 12-24 x 1/2 OHS
--	070-0415-00			2	MANUAL, instruction (not shown)

NOTES

ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description			S/N Range
		Bulbs			
B601	150-031	Incandescent, GE #44 Graticule Light			
B602	150-031	Incandescent, GE #44 Graticule Light			
B603	150-018	Incandescent, GE #44 Pilot Light			
B856	150-025	Neon, NE-2E			101-3259
B856	150-0030-00	Neon, NE-2V			3260-up
B857	150-025	Neon, NE-2E			101-3259
B857	150-0030-00	Neon, NE-2V			3260-up
B903	150-028	Neon, RT2-32-1A			
		Capacitors			

Tolerance ±20% unless otherwise indicated.

Tolerance of all electrolytic capacitors as follows (with exceptions):

3V — 50V = —10%, +250%
51V — 350V = —10%, +100%
351V — 450V = —10%, + 50%

C611	285-510	0.01 μf	MT		400 v
C616	285-510	0.01 μf	MT		400 v
C640A,B	Use 290-0224-00	340 μf x 10 μf	EMC		250 v
C642A,B	Use 290-0224-00	340 μf x 10 μf	EMC		250 v
C644A,B	Use 290-0224-00	340 μf x 10 μf	EMC		250 v
C646	Use 290-0185-00	2 x 40 μf	EMC		250 v
C650	285-510	0.01 μf	MT		400 v
C667	290-213	10 μf	EMT		450 v
C670	285-510	0.01 μf	PTM		400 v
C720A	Use 290-0212-00	2000 μf	EMC		25 v
C720B	Use 290-0212-00	2000 μf	EMC		25 v
C732	290-215	100 μf	EMT		25 v
C737	283-026	0.2 μf	Cer		25 v
C757	290-215	100 μf	EMT		25 v
C760	281-027	0.7-3 pf	Tub.	Var	
C761	281-027	0.7-3 pf	Tub.	Var	
C762	283-003	0.01 μf	Cer		150 v
C801	283-006	0.02 μf	Cer		600 v
C803	283-000	0.001 μf	Cer		500 v
C807	285-502	0.001 μf	MT		1000 v
C822	283-071	0.0068 μf	Cer		5000 v
C830	283-071	0.0068 μf	Cer		5000 v
C832	283-071	0.0068 μf	Cer		5000 v
C837	283-082	0.01 μf	Cer		4000 v
C841	285-519	0.047 μf	MT		400 v
C842	283-071	0.0068 μf	Cer		5000 v
C849	283-000	0.001 μf	Cer		500 v
C853	283-071	0.0068 μf	Cer		5000 v
C876	290-225	6 μf	EMT		300 v
C878	281-523	100 pf	Cer		350 v

Capacitors *(Cont'd)*

Ckt No.	Tektronix Part No.	Description				S/N Range
C884	281-524	150 pf	Cer	500 v		
C904	290-225	6 μf	EMT	300 v		
C916	285-527	0.1 μf	PTM	600 v		
C918	285-527	0.1 μf	PTM	600 v		
C932	285-537	0.5 μf	PTM	400 v		
C945	285-555	0.1 μf	MT	100 v		
C947	285-555	0.1 μf	MT	100 v		
C952	283-004	0.02 μf	Cer	150 v		
C958	Use 290-164	1 μf	EMT	150 v		
C962	283-004	0.02 μf	Cer	150 v		
C968	Use 290-164	1 μf	EMT	150 v		
C970	281-525	470 pf	Cer	500 v		
C985	285-566	0.022 μf	PTM	200 v	10%	101-359
C985	285-629	0.047 μf	PTM	100 v	10%	360-up

Diodes

				S/N Range
D640A,B,C,D	152-066	Silicon	1N3194	
D642A,B,C,D	152-066	Silicon	1N3194	
D644A,B,C,D	152-066	Silicon	1N3194	
D646	152-066	Silicon	1N3194	
D663	*152-107	Silicon	Replaceable by 1N647	
D664	*152-107	Silicon	Replaceable by 1N647	
D720	152-035	Silicon	1N1563A	
D721	152-035	Silicon	1N1563A	
D744	*152-0185-00	Silicon	Replaceable by 1N4152	X2100-up
D762	152-008	Germanium		
D763	*152-061	Silicon	Tek Spec	
D837	152-0066-00	Silicon	1N3194	X2100-up
D838	152-066	Silicon	1N3194	
D839	152-066	Silicon	1N3194	
D849	*152-107	Silicon	Replaceable by 1N647	
D908	*152-107	Silicon	Replaceable by 1N647	
D911	*152-107	Silicon	Replaceable by 1N647	
D916	*152-107	Silicon	Replaceable by 1N647	
D918	*152-107	Silicon	Replaceable by 1N647	
D920	*152-107	Silicon	Replaceable by 1N647	
D926	*152-107	Silicon	Replaceable by 1N647	
D933	*152-107	Silicon	Replaceable by 1N647	
D934	*152-107	Silicon	Replaceable by 1N647	
D935	*152-107	Silicon	Replaceable by 1N647	
D937	152-094	Zener	¾ M50Z10 ¾ w, 50 v, 10%	101-2899
D937	152-0150-00	Zener	1N3037B 1 w, 51 v, 5%	2900-up
D948	Use *152-107	Silicon	Replaceable by 1N647	
D953	*152-107	Silicon	Replaceable by 1N647	
D955	*152-107	Silicon	Replaceable by 1N647	
D963	*152-107	Silicon	Replaceable by 1N647	
D965	*152-107	Silicon	Replaceable by 1N647	
D972	152-141	Silicon	1N4152	
D973	152-141	Silicon	1N4152	101-359
D973	*152-061	Silicon	Tek Spec	360-up

Fuses

Ckt. No.	Tektronix Part No.	Description	S/N Range
F601	159-005	3 Amps 3AG Slo-Blo 117 v oper 50 & 60 cycle	
F601	159-003	1.6 Amps 3AG Slo-Blo 234 v oper 50 & 60 cycle	
F720	159-023	2 Amps 3AG Slo-Blo	

Inductors

L860	*108-285	Beam Rotator	
L948	*108-054	6.4 μh	

Transistors

Q624	*151-087	Selected from 2N1131	
Q734	151-040	2N1302	
Q744	151-042	2N1378	
Q757	151-060	2N1545	
Q975	*151-096	Selected from 2N1893	
Q985	*151-096	Selected from 2N1893	

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R601†	311-340	50 Ω		Var	WW	SCALE ILLUM	101-2999
R601†	311-0672-00	50 Ω		Var	WW	SCALE ILLUM	300-up
R602	308-142	30 Ω	3 w		WW	5%	
R609	302-106	10 meg	½ w				
R610	302-104	100 k	½ w				
R611	302-102	1 k	½ w				
R612	302-272	2.7 k	½ w				
R616	311-405	10 k		Var	WW	—100 VOLTS	
R617	308-186	80 k	½ w		WW	1%	101-1589
R617	308-0186-01	80 k	1 w		WW	1%	1590-up
R618	308-226	10 k	½ w		WW	1%	
R619	302-224	220 k	½ w				
R624	302-473	47 k	½ w				
R625	302-222	2.2 k	½ w				
R626	302-184	180 k	½ w				
R627	302-102	1 k	½ w				
R628	308-176	4 k	20 w		WW	5%	
R629	308-101	5.5 k	5 w		WW		
R632	302-102	1 k	½ w				
R633	302-473	47 k	½ w				
R635	301-302	3 k	½ w			5%	
R640	304-100	10 Ω	1 w				
R642	304-100	10 Ω	1 w				
R644	304-100	10 Ω	1 w				
R646	304-101	100 Ω	1 w				
R650	322-609	333 k	¼ w		Prec	1%	
R651	322-614	250 k	¼ w		Prec	1%	

†Furnished as a unit with SW601.

©

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
R652	302-102	1 k	½ w			
R653	302-225	2.2 meg	½ w			
R654	302-474	470 k	½ w			
R655	302-685	6.8 meg	½ w			
R656	311-068	500 k	.2 w	Var		+125 VOLTS
R657	302-684	680 k	½ w			
R658	302-273	27 k	½ w			
R659	302-333	33 k	½ w			
R663	302-102	1 k	½ w			
R664	302-102	1 k	½ w			
R666	308-176	4 k	2 w		WW	5%
R667	308-176	4 k	2 w		WW	5%
R668	308-217	5.5 k	5 w		WW	5%
R670	323-482	1.02 meg	½ w		Prec	1%
R671	322-609	333 k	¼ w		Prec	1%
R672	302-102	1 k	½ w			
R673	302-105	1 meg	½ w			
R675	302-825	8.2 meg	½ w			
R676	311-068	500 k	.2 w	Var		+300 VOLTS
R677	304-224	220 k	1 w			
R678	302-394	390 k	½ w			
R679	302-333	33 k	½ w			
R730	311-068	500 k	.2 w	Var		−12.2 VOLTS
R731	322-223	2.05 k	¼ w		Prec	1%
R732	324-306	15 k	1 w		Prec	1%
R733	301-394	390 k	½ w			5%
R734	302-334	330 k	½ w			
R735	302-272	2.7 k	½ w			
R737	302-151	150 Ω	½ w			
R744	308-231	220 Ω	3 w		WW	5%
R754	302-471	470 Ω	½ w			
R759	302-104	100 k	½ w			
R762	316-473	47 k	¼ w			
R763	316-105	1 meg	¼ w			
R764	316-105	1 meg	¼ w			
R801	306-681	680 Ω	2 w			
R802	302-562	5.6 k	½ w			
R803	306-273	27 k	2 w			
R806	302-104	100 k	½ w			
R807	302-472	4.7 k	½ w			
R813	302-101	100 Ω	½ w			
R815	302-474	470 k	½ w			
R816	302-102	1 k	½ w			
R831	302-104	100 k	½ w			
R832	302-106	10 meg	½ w			

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
R833	311-349	2 meg		Var	INTENSITY	
R834	302-105	1 meg	½ w			
R835A	306-565	5.6 meg	2 w			
R835B	306-565	5.6 meg	2 w			
R835C	306-565	5.6 meg	2 w			
R835D	306-685	6.8 meg	2 w			
R835E	306-685	6.8 meg	2 w			
R836	302-223	22 k	½ w			
R837	302-471	470 Ω	½ w			
R838	301-242	2.4 k	½ w		5%	
R839	302-104	100 k	½ w			
R840	301-125	1.2 meg	½ w		5%	
R841	311-306	2.5 meg		Var	HIGH VOLTAGE	
R842A	306-335	3.3 meg	2 w			
R842B	306-335	3.3 meg	2 w			
R842C	306-275	2.7 meg	2 w			
R842D	306-275	2.7 meg	2 w			
R844	311-447	5 meg		Var	FOCUS	
R846	304-225	2.2 meg	1 w			
R847	302-103	10 k	½ w			
R848	302-334	330 k	½ w			
R849	316-336	33 meg	¼ w			
R850	302-223	22 k	½ w			
R851	302-104	100 k	½ w			
R852	302-273	27 k	½ w			
R853	302-471	470 Ω	½ w			
R854	302-105	1 meg	½ w			
R860	311-317	2 x 1 k		Var	TRACE ALIGNMENT	
R861	302-680	68 Ω	½ w			
R864	311-206	250 k		Var	ASTIGMATISM	
R865	316-472	4.7 k	¼ w			
R867	316-472	4.7 k	¼ w			
R868	316-472	4.7 k	¼ w			
R869	302-564	560 k	½ w			
R870	301-393	39 k	½ w		5%	
R871	311-408	20 k		Var	CAL AMPL	
R872	301-154	150 k	½ w		5%	
R873	302-103	10 k	½ w			
R876	301-153	15 k	½ w		5%	101-3389
R876	323-0206-00	15 k	½ w		1%	3390
R877	301-183	18 k	½ w		5%	101-3389
R877	323-0314-00	18.2 k	½ w		1%	3390
R878	301-564	560 k	½ w		5%	101-3389
R878	323-0455-00	15 k	½ w		1%	3390
R879	301-114	110 k	½ w		5%	101-3389
R879	323-0389-00	110 k	½ w		1%	3390
R883	305-223	22 k	2 w		5%	
R885	324-313	17.8 k	1 w	Prec	1%	
R886	323-217	1.78 k	½ w	Prec	1%	

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description				S/N Range
R887	321-121	178 Ω	1/8 w		Prec 1%	
R888	323-030	20 Ω	1/2 w		Prec 1%	
R890	323-217	1.78 k	1/2 w		Prec 1%	
R891	321-121	178 Ω	1/8 w		Prec 1%	
R892	323-666	19.8 Ω	1/2 w		Prec 1%	
R898	323-136	255 Ω	1/2 w		Prec 1%	
R899	*308-090	1/4 Ω	1 w		WW	
R903	304-333	33 k	1 w			
R904	311-026	100 k		Var		STORAGE LEVEL
R906	311-374	250 k		Var		NON-STORAGE LEVEL
R908	302-224	220 k	1/2 w			
R909	302-684	680 k	1/2 w			
R911	302-224	220 k	1/2 w			
R912	302-684	680 k	1/2 w			
R916	316-153	15 k	1/4 w			
R918	316-153	15 k	1/4 w			
R920	302-104	100 k	1/2 w			
R924	302-224	220 k	1/2 w			
R926	302-104	100 k	1/2 w			
R928	302-224	220 k	1/2 w			
R930	311-374	250 k		Var		COVERAGE 1
R931	302-683	68 k	1/2 w			
R932	302-333	33 k	1/2 w			
R933	301-334	330 k	1/2 w			5%
R934	301-224	220 k	1/2 w			5%
R935	302-154	150 k	1/2 w			
R937	302-103	10 k	1/2 w			
R938	311-023	50 k		Var		COVERAGE 2
R940	311-018	20 k		Var		GEOMETRY
R941	302-822	8.2 k	1/2 w			
R944	311-068	500 k	.2 w	Var		B FLOOD-GUN BIAS
R945	316-105	1 meg	1/4 w			
R946	311-068	500 k	.2 w	Var		A FLOOD-GUN BIAS
R947	316-105	1 meg	1/4 w			
R948	315-103	10 k	1/4 w			5%
R950	316-226	22 meg	1/4 w			
R951	316-185	1.8 meg	1/4 w			
R952	315-512	5.1 k	1/4 w			5%
R953	301-683	68 k	1/2 w			5%
R954	304-684	680 k	1 w			
R957	303-563	56 k	1 w			5%
R958	301-183	18 k	1/2 w			5%
R960	316-226	22 meg	1/4 w			
R961	316-185	1.8 meg	1/4 w			
R962	315-512	5.1 k	1/4 w			

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
R963	301-683	68 k	½ w		5%	
R964	304-684	680 k	1 w			
R967	303-563	56 k	1 w		5%	
R968	301-183	18 k	½ w		5%	
R970	316-103	10 k	¼ w			
R972	316-474	470 k	¼ w			
R974	316-104	100 k	¼ w			
R976	316-474	470 k	¼ w			X360-up
R977†	311-432	2 meg		Var	WRITING RATE INCREASE	
R978	316-104	100 k	¼ w			101-359
R978	316-683	68 k	¼ w			360-up
R979	316-184	180 k	¼ w			101-359
	316-334	330 k	¼ w			360-up
R983	302-123	12 k	½ w			
R984	311-016	10 k		Var	PULSE AMPL	
R985	302-182	1.8 k	½ w			

Switches

	Unwired	Wired			
SW601††	311-340			POWER OFF	101-2999
SW601††		311-0672-00		POWER OFF	3000-up
SW854	260-449		Slide	CRT CATHODE SELECTOR	
SW868	*050-201		Replacement Kit	LOCATE (Trace)	101-329
SW868	260-645		Push-Button	LOCATE (Trace)	330-up
SW870	260-394	*262-652		CALIBRATOR	
SW910	260-609		Lever	UPPER (Display)	
SW911	260-609		Lever	LOWER (Display)	
SW948	*050-201		Replacement Kit	INTEGRATE	101-329
SW948	260-645		Push-Button	INTEGRATE	330-up
SW977†††	311-432			PULL ON	
TK601	260-208		Thermal cutout 133°		

Transformers

T601	*120-296	L. V. Power
T801	*120-297	H. V. Power

Electron Tubes

V609	154-291	OG3
V627	154-307	7233
V634	154-187	6DJ8
V654	154-022	6AU6
V667	154-056	6080

†Furnished as a unit with SW977.

††Furnished as a unit with R601.

†††Furnished as a unit with R977.

Electron Tubes *(continued)*

Ckt. No.	Tektronix Part No.	Description	S/N Range
V674	154-022	6AU6	
V800	154-167	6CZ5	
V814	154-046	12BH7	
V822	154-051	5642	
V832	154-051	5642	
V859	*154-410	T5640-200 CRT	
V884	154-278	6BL8	
V913	154-041	12AU7	
V955	154-278	6BL8	
V965	154-278	6BL8	

RACKMOUNTING

General Information

This instrument is designed to fit most 19-inch wide racks with EIA standard dimensions. The instrument front panel requires at least a 7-inch high mounting space.

The last foldout page is a dimensional drawing of the instrument. Any plug-in units, probes, or other accessories that may be used with this instrument are not shown.

Determining the Mounting Method

Use Method 1 if the instrument is to be mounted directly to the front rail of the rack as shown in Fig 2. Use Method 2 if the instrument is to be mounted in the rack with slideout tracks, and the rack has both front and rear rails (see Fig. 3). Use Method 3 for racks that have only a front rail or do not have the proper dimensions between front and rear rails (see Fig. 4).

Enough space should be provided between the rear of the instrument and any obstruction at the rear of the rack to allow for proper air circulation and power cord clearance. At least 60 cu. ft. of air per minute at a temperature less than 50°C should pass through the instrument.

The mounting method will determine the effective panel thickness of the instrument. If the instrument is bolted directly to the rack (Method 1) effective panel thickness will be $\frac{7}{32}$". When slideout tracks are used, the surface of the instrument panel may be as little as $\frac{7}{32}$" from the rack-mounting surface, or as much as $\frac{5}{16}$", depending on the type of screws used and whether the front flanges of the slideout tracks are mounted behind the front rail (Fig. 9c) or in front of it (Fig. 8c). For minimum effective panel thickness, countersink flat-head screws into the front rail of the rack. However, this should not be attempted with racks having thin sheet metal mounting rails.

NOTE

If slideout tracks are used (mounting Methods 2 and 3), the opening between the front rails of the rack must be at least 17⅝" for a rack in which the front flange of the slideout-track stationary section is mounted behind the front rail as shown in Fig. 9c; at least 17¾" if the flange is mounted in front of the front rail as shown in Fig. 8c; or at least $17\frac{13}{16}$" if the instrument is mounted in a cradle assembly as shown in Fig. 4.

Method 1—Direct Rackmounting

This type of mounting is intended for instruments which are not equipped with slideout tracks. The front panel of the instrument has two notches on each side so the instrument can be mounted directly to the front rail of the rack. Front-panel dimensions and notch locations are shown on the Dimensional Drawing. When mounted in this manner, the rear of the instrument does not need support unless subjected to shock or vibration. Braces can be added at the rear of the instrument if more support is needed.

To mount the instrument directly to the front rails of the rack (see Fig. 2) proceed as follows:

1. Select four oval-head screws (10-32 or 12-24) that match the tapped holes in the rack front rail from the hardware kit. If the holes in the front rail are not tapped, nuts, washers, and longer screws must be used.
2. First, place a cup washer and then a plastic washer on each screw. The plastic washers will protect the instrument front panel.
3. Hold the instrument in the desired position in the rack and fasten securely to the front rail with the oval-head screws.

Method 2—Rackmounting With Slideout Tracks

An instrument which has slideout tracks (optional item) can be mounted in a rack which has a rear support rail to which the reversible rear support bracket can be attached. Mounted in this manner, the instrument is locked into the rack with the two RELEASE knobs on the front panel. When the instrument is released from the rack, it can be pulled out to the fully extended position (see Fig. 3) and then tilted up or down and locked in one of six positions: 45°, 90°, and 105° above or below horizontal. These positions permit most routine maintenance and calibration functions to be performed without removing the instrument from the rack.

The slideout tracks consist of two assemblies: one for the right and one for the left side. Each assembly consists of three sections as illustrated in Fig. 1. The stationary section attaches to the front and rear rails of the rack and the chassis section attaches to the instrument. The intermediate section fits between the stationary and chassis sections and allows the instrument to be extended out of the rack.

The small-hardware components included with the slideout tracks are shown in Figs. 5 and 6. The hardware shown in Fig. 5 is used to mount the stationary sections to the rack. The hardware shown in Fig. 6 is used to mount the chassis sections to the instrument. Since the hardware included is intended to make the slideout tracks compatible to a variety of racks, there will be more parts than needed for this installation. Use only the necessary hardware as described in the following procedures.

Chassis Section Installation—Use the following procedure to attach the chassis sections if they are not already installed. See Fig. 6 for installation details.

1. Remove the plug-in units (if any) from their compartments.
2. Remove the bottom dust cover from the instrument.
3. Remove the nut, lockwasher, and flat washer from the eccentric pivot screw on the chassis section. Hold the chassis section parts, including the pivot screw, so the assembly does not fall apart.
4. Mount the assembly so the pivot screw goes into the hole provided and the detent bar assembly is aligned with the prepunched holes on the side of the instrument.
5. Replace the hardware removed in step 3. Do not tighten the nut.
6. Fasten the detent bar assembly to the instrument side using six 8-32 BHS screws. Align the detent bar so it is parallel with the bottom of the instrument before tightening the screws.
7. Turn the pivot screw until the outer slide is parallel to the bottom of the instrument. Hold the screw in this position and tighten the nut.
8. Make sure the detent release knob is screwed tightly into the detent bar.

Stationary Section Installation—The stationary and intermediate sections of the slideout tracks are shipped as matched sets and should not be separated. The assembly for the right side of the rack is shown in Fig. 1. Use the following procedure to mount both sets. Installation details are shown in Figs. 7, 8, and 9.

1. If the instrument is to be mounted directly above or below another instrument in the rack, select the proper front-rail mounting holes using the measurements shown in Fig. 7.
2. If the mounting holes are tapped for 10-32 screws, the left stationary section can be mounted in front of the rail as shown in Fig. 8c provided the distance between the front rails is a minimum of 17¾". Mount the rear support as shown in Figs. 8a or 8b. Using Fig. 8 as a guide, mount the right stationary section. (Note: If the mounting holes are tapped but the distance between the front rails is less than specified, the mounting holes should be drilled out and the stationary section mounted as described in the following step.)
3. If the mounting holes are not tapped for 10-32 screws, mount the left stationary section behind the front rail as shown in Fig. 9c. Mount the rear support as shown in Figs. 9a or 9b. Using Fig. 9 as a guide, mount the right stationary section.

Instrument Installation—Before installing the instrument, check the alignment of the chassis sections as shown in Fig. 12. Be sure the outer slides are parallel with each other. To install the instrument in the rack, follow the step-by-step procedure given in Fig. 10.

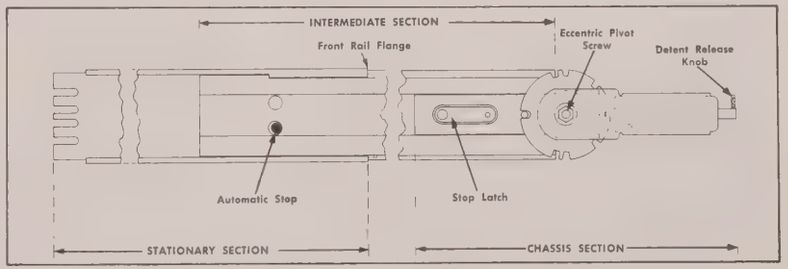


Fig. 1. Slideout track assembly for right side.

Adjustments—To adjust the slideout tracks for best operation, use the following procedure:

1. Position the instrument in the rack as shown in Fig. 11. Follow the adjustment procedure given in Fig. 11 to horizontally center the instrument in the rack. To center the instrument vertically, use the same procedure but move the instrument up or down for proper spacing.
2. If the instrument does not slide smoothly (even after the centering adjustment), pull the instrument out of the rack and loosen the screws that hold the rear brackets to the rear rail. Push the instrument completely into the rack and tighten the screws.

Method 3—Rackmounting With a Cradle Assembly

A cradle assembly (optional) can be used to mount the instrument in a rack which has only a front rail or does not not have the proper dimensions between the front and rear rails. The cradle assembly provides a rear support for the slideout tracks without affecting their operation. Additional bracing should be added to the rear of the cradle assembly if severe vibration or shock is anticipated.

Mounting instructions for this type of installation are included with the cradle assembly. The cradle assembly can be ordered from your Tektronix Field Office or representative.

Maintenance

The slideout tracks require no lubrication. The special finish on the sliding surfaces provides permanent lubrication.

Fig. 2. The instrument mounted directly to the front rail (Method 1).

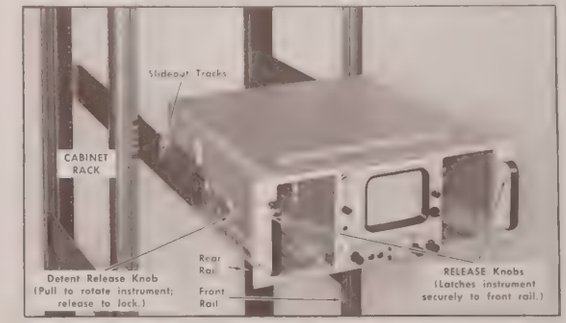

Slideout Tracks
CABINET RACK
Detent Release Knob (Pull to rotate instrument; release to lock.)
Rear Rail
Front Rail
RELEASE Knobs (Latches instrument securely to front rail.)

Fig. 3. The instrument mounted with slideout tracks, supported at front and rear (Method 2).

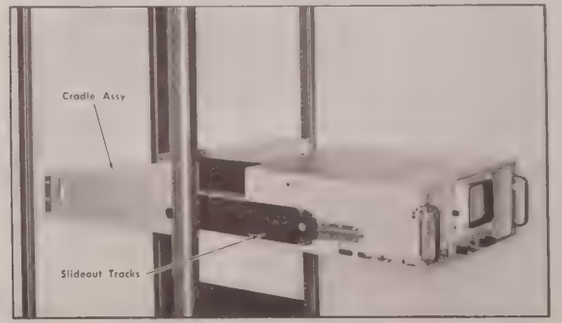


Fig. 4. The instrument mounted with a cradle assembly to support the rear (Method 3).

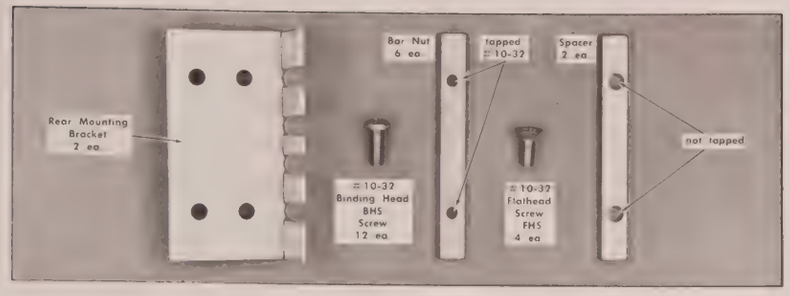


Fig. 5. Small hardware components for mounting the stationary sections to the rack rails

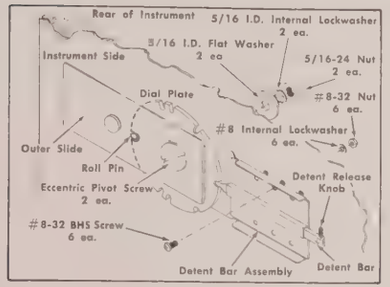


Fig. 6. Details for mounting the left chassis section to the instrument.

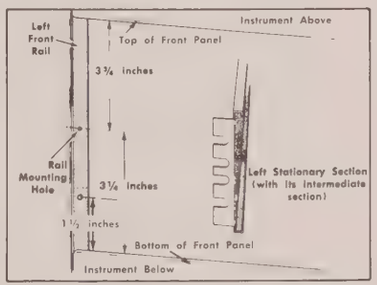


Fig. 7. Vertical mounting position of left stationary section. The same dimensions apply to the right stationary section.

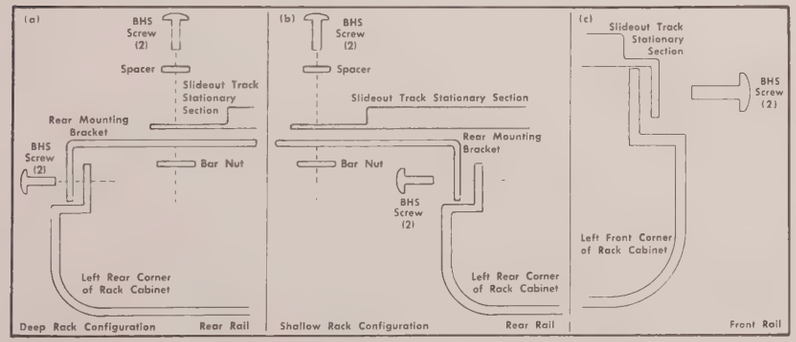


Fig. 8. Mounting the left stationary section to front rail tapped for 10-32 screws.

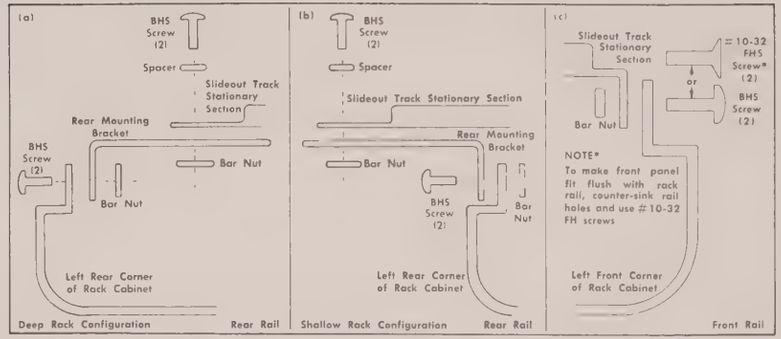


Fig. 9. Mounting the left stationary section to untapped front rail.

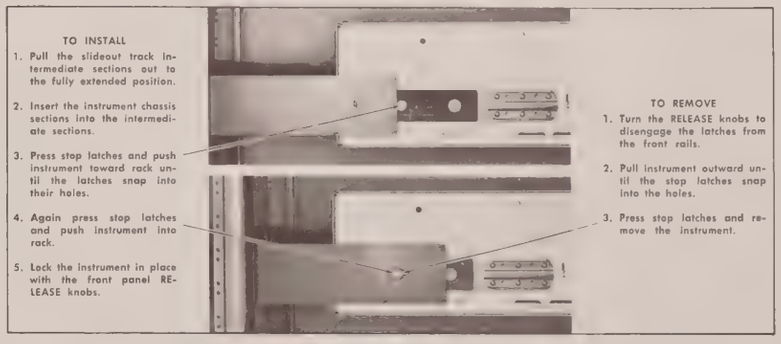

TO INSTALL
1. Pull the slideout track intermediate sections out to the fully extended position.
2. Insert the instrument chassis sections into the intermediate sections.
3. Press stop latches and push instrument toward rack until the latches snap into their holes.
4. Again press stop latches and push instrument into rack.
5. Lock the instrument in place with the front panel RELEASE knobs.
TO REMOVE
1. Turn the RELEASE knobs to disengage the latches from the front rails.
2. Pull instrument outward until the stop latches snap into the holes.
3. Press stop latches and remove the instrument.

Fig. 10. Installing and removing the instrument.

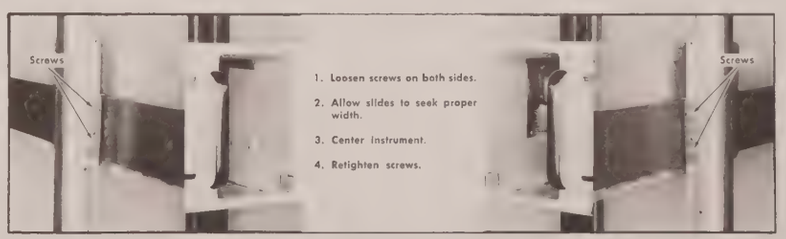


Fig. 11. Adjustment of the slideout tracks.

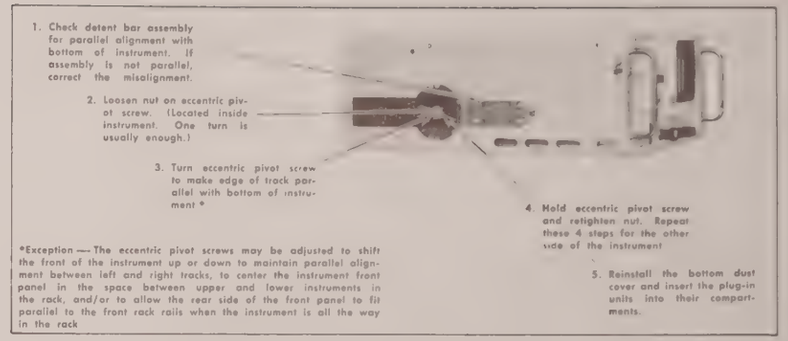

1. Check detent bar assembly for parallel alignment with bottom of instrument. If assembly is not parallel, correct the misalignment.
2. Loosen nut on eccentric pivot screw. (Located inside instrument. One turn is usually enough.)
3. Turn eccentric pivot screw to make edge of track parallel with bottom of instrument *
4. Hold eccentric pivot screw and retighten nut. Repeat these 4 steps for the other side of the instrument
5. Reinstall the bottom dust cover and insert the plug-in units into their compartments.
*Exception — The eccentric pivot screws may be adjusted to shift the front of the instrument up or down to maintain parallel alignment between left and right tracks, to center the instrument front panel in the space between upper and lower instruments in the rack, and/or to allow the rear side of the front panel to fit parallel to the front rack rails when the instrument is all the way in the rack

Fig. 12. Adjustment of the chassis section

PARTS LIST

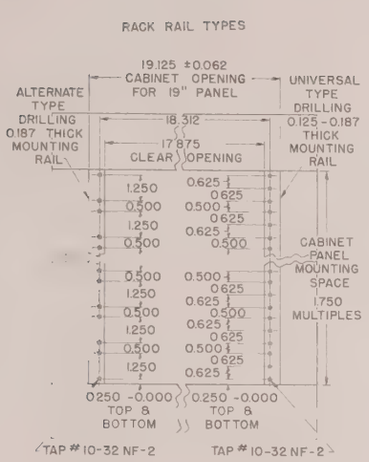
SLIDEOUT TRACK ASSEMBLY

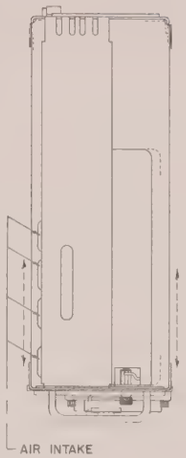
REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY	DESCRIPTION
See Fig 1	351-050			1	TRACK, SLIDEOUT, ASSEMBLY
					Consisting Of:
	351-027			1	TRACK, SLIDEOUT, chassis section
					Mounting Hardware Included
	NO NUMBER			12	SCREW
	NO NUMBER			12	LOCKWASHER
	NO NUMBER			12	NUT
	351-011			1	TRACK, SLIDEOUT, stationary and intermediate sections, right
					Mounting Hardware Included:
	NO NUMBER			1	BRACKET
	NO NUMBER			1	SPACER
	NO NUMBER			3	SPACER, with threaded holes
	NO NUMBER			2	SCREW, FHS, phillips
	NO NUMBER			6	SCREW, phillips
	351-010			1	TRACK SLIDEOUT, stationary and intermediate sections, left
					Mounting Hardware Included:
	NO NUMBER			1	BRACKET
	NO NUMBER			1	SPACER
	NO NUMBER			3	SPACER, with threaded holes
	NO NUMBER			2	SCREW, FHS, phillips
	NO NUMBER			6	SCREW, phillips

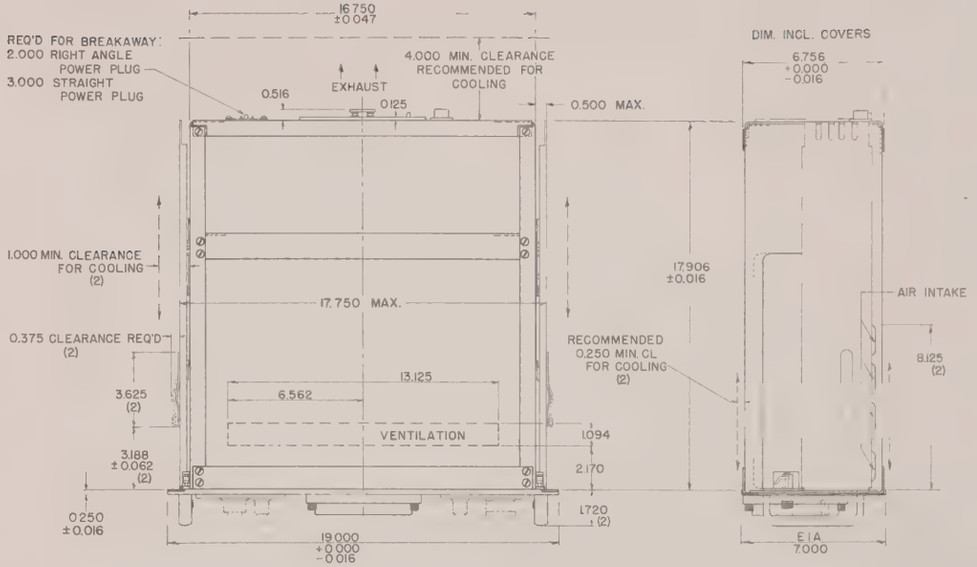
12 INCH

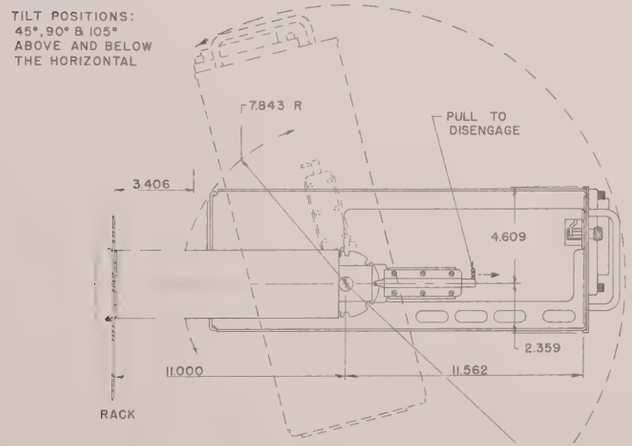
1 INCH

RACK RAIL TYPES

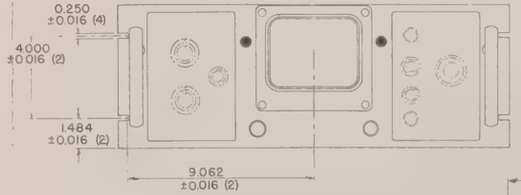


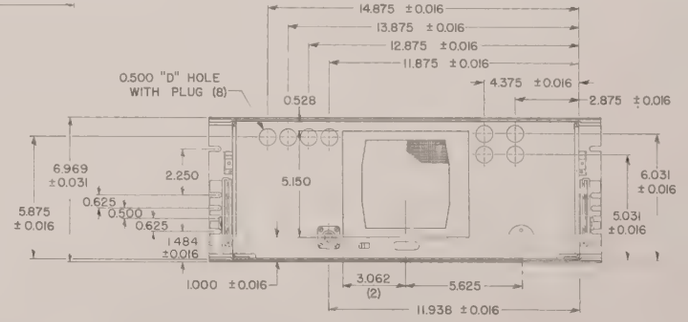




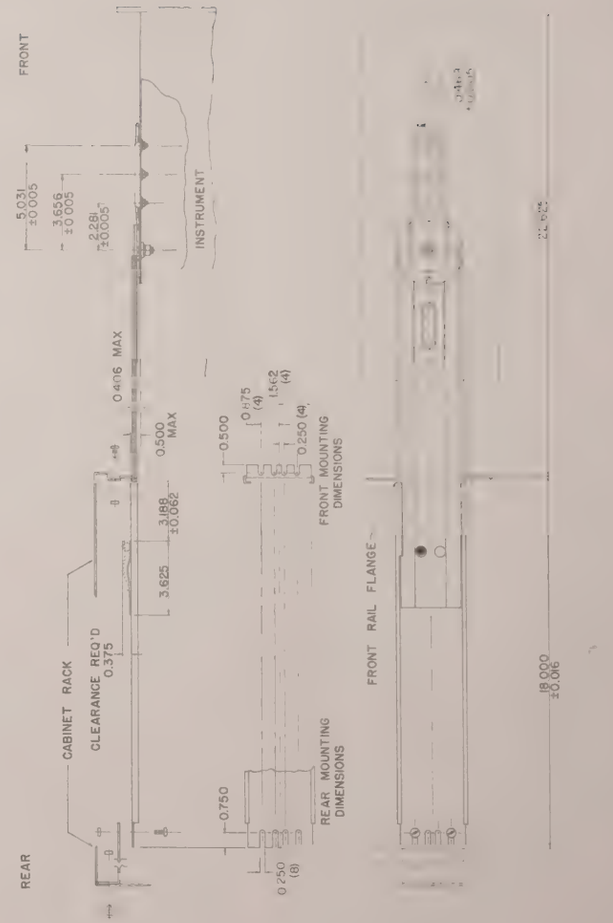


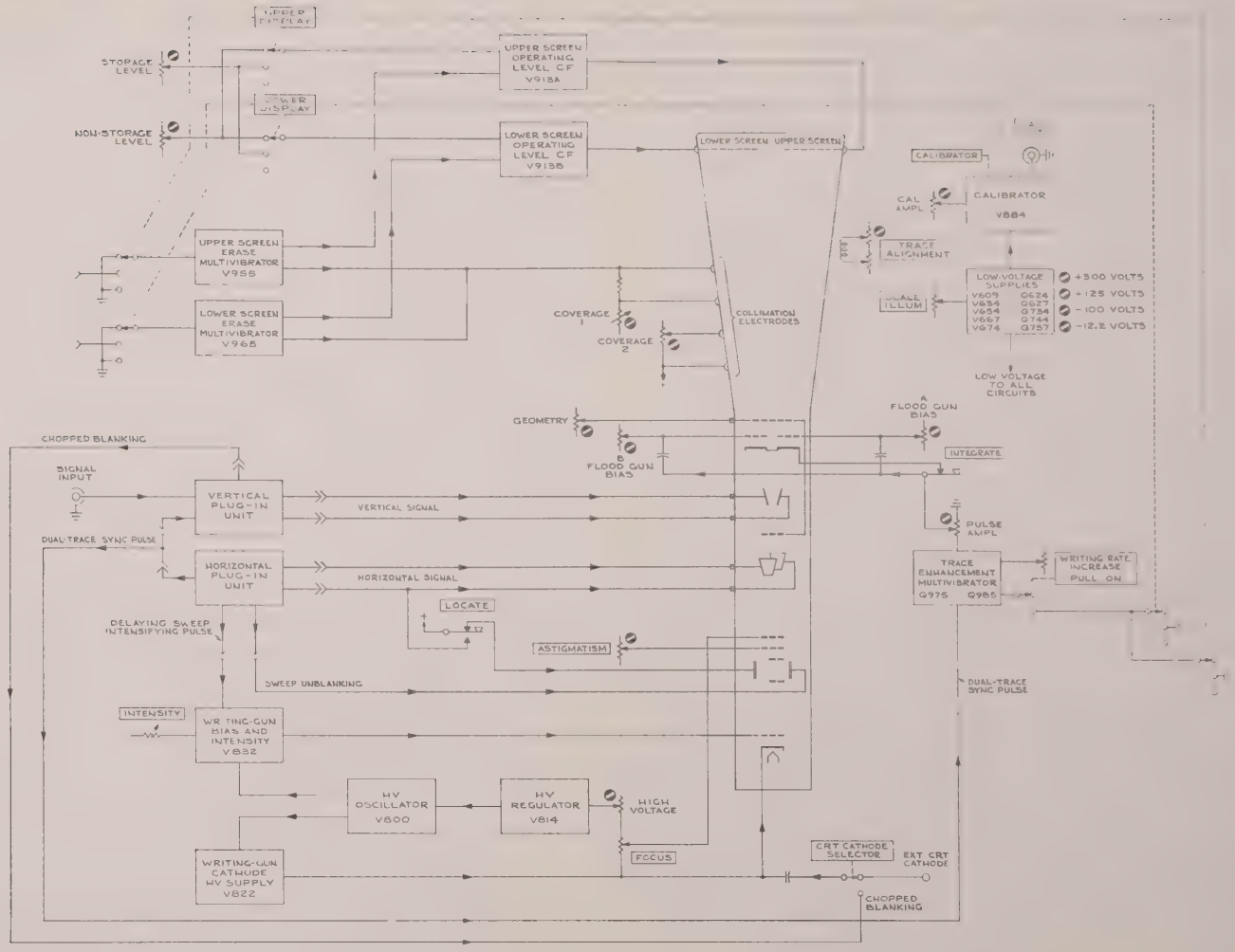
NOTE:
TRACK ASSY SUPPLIED ONLY WITH RM 564 MOD 171





REAR VIEW




UPPER DISPLAY
STORAGE LEVEL
LOWER DISPLAY
NON-STORAGE LEVEL
UPPER SCREEN OPERATING LEVEL CF V918A
LOWER SCREEN OPERATING LEVEL CF V913B
LOWER SCREEN UPPER SCREEN
UPPER SCREEN ERASE MULTIVIBRATOR V958
LOWER SCREEN ERASE MULTIVIBRATOR V968
COVERAGE 1
COVERAGE 2
COLLIMATION ELECTRODES
CALIBRATOR
CAL AMPL
CALIBRATOR V884
TRACE ALIGNMENT
LOW-VOLTAGE SUPPLIES
V609 Q624 +300 VOLTS
V634 Q627 +125 VOLTS
V654 Q734 -100 VOLTS
V667 Q744 -12.2 VOLTS
V674 Q757 -12.2 VOLTS
ALL ILLUM
LOW VOLTAGE TO ALL CIRCUITS
GEOMETRY
A FLOOD GUN BIAS
B FLOOD GUN BIAS
INTEGRATE
CHOPPED BLANKING
SIGNAL INPUT
VERTICAL PLUG-IN UNIT
VERTICAL SIGNAL
DUAL-TRACE SYNC PULSE
HORIZONTAL PLUG-IN UNIT
HORIZONTAL SIGNAL
PULSE AMPL
TRACE ENHANCEMENT MULTIVIBRATOR Q975 Q985
WRITING RATE INCREASE PULL ON
LOCATE
DELAYING SWEEP INTENSIFYING PULSE
ASTIGMATISM
SWEEP UNBLANKING
DUAL-TRACE SYNC PULSE
INTENSITY
WRITING-GUN BIAS AND INTENSITY V832
HV OSCILLATOR V800
HV REGULATOR V814
HIGH VOLTAGE
FOCUS
WRITING-GUN CATHODE HV SUPPLY V822
CRT CATHODE SELECTOR
EXT CRT CATHODE
CHOPPED BLANKING

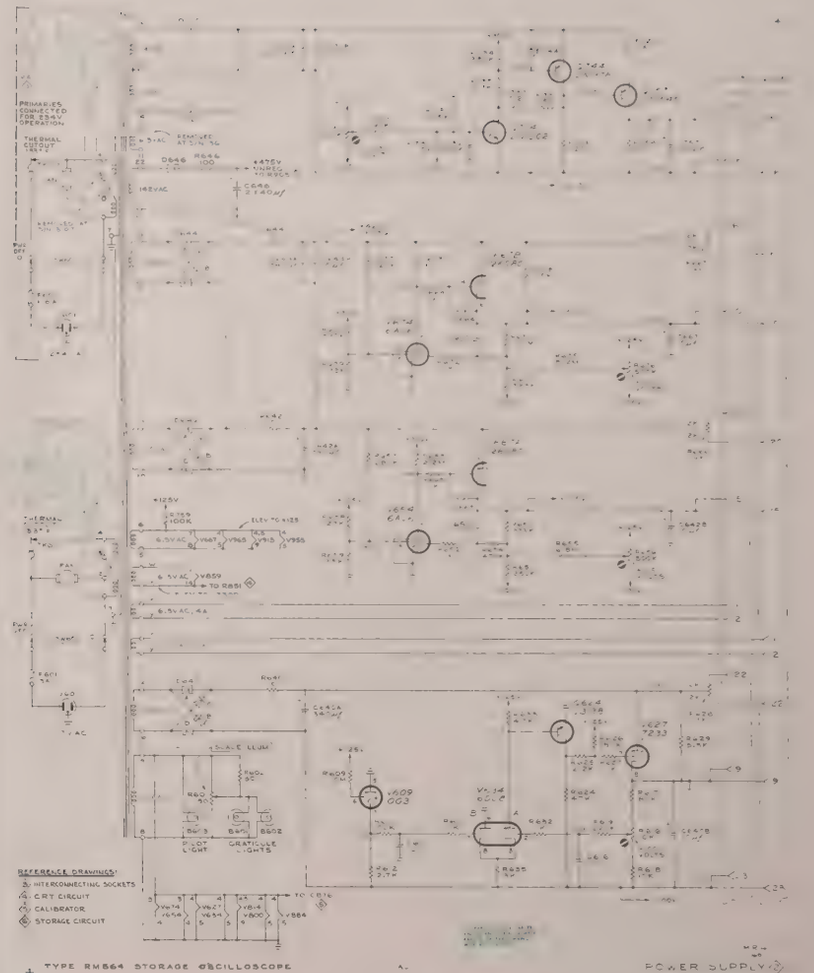
TEST CONDITIONS

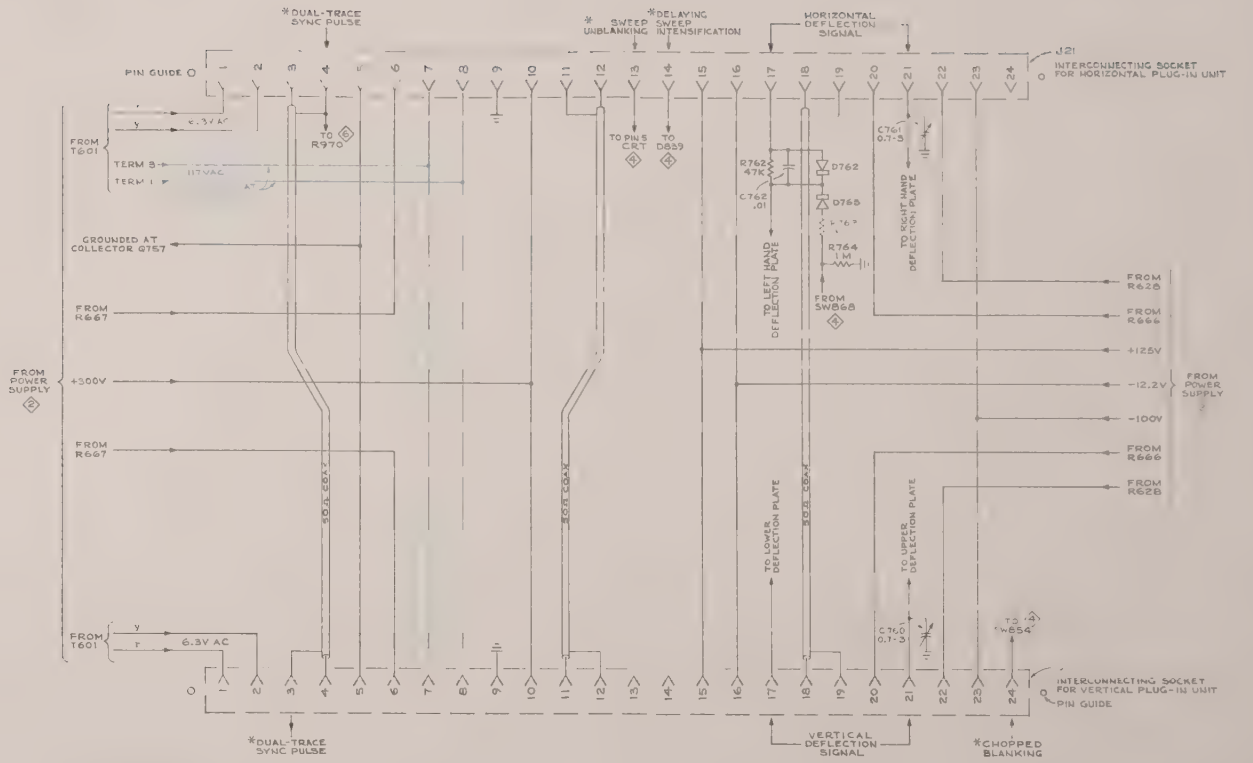
All VOLTAGE READINGS were obtained under the following conditions unless otherwise noted on the specific diagrams:

Plug-In Units	Installed
Line Voltage	117 volts
Vertical Input Signal	None
Dc Voltmeter Impedance	20,000 Ω/volt
Control Settings:	
INTENSITY	Counterclockwise
FOCUS	Centered
CALIBRATOR	OFF
Upper DISPLAY	NON STORE
Lower DISPLAY	NON STORE
WRITING RATE INCREASE	Off (pushed in) and counter-clockwise
SCALE ILLUM	On
Sweep Mode	Single Sweep

Circuit VOLTAGE READINGS shown in blue are in volts dc, except where otherwise specified.

VOLTAGE READINGS may vary somewhat between instruments due to normal manufacturing tolerances and component characteristics.



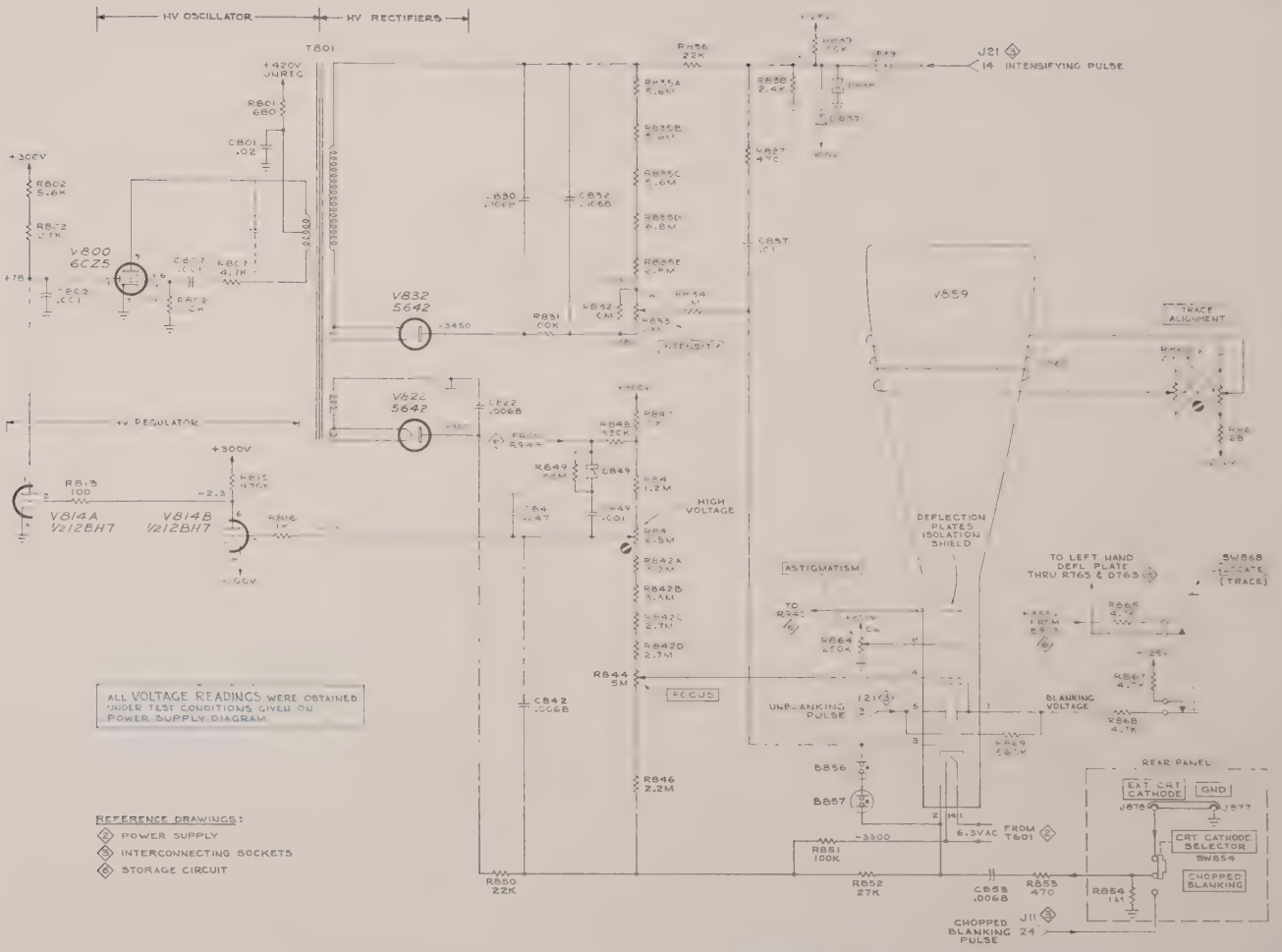


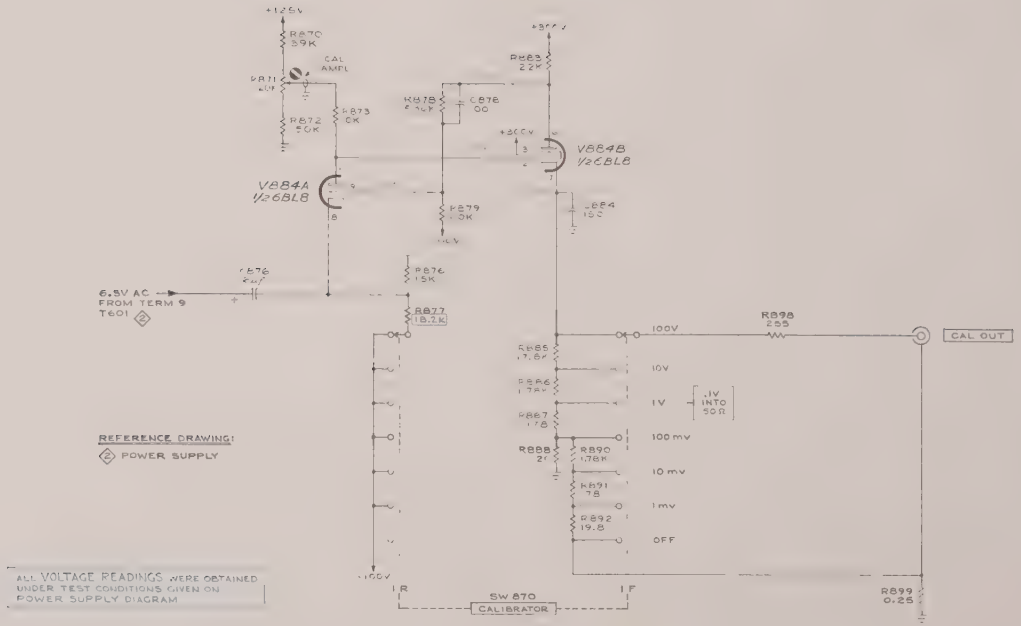
REFERENCE DRAWINGS:

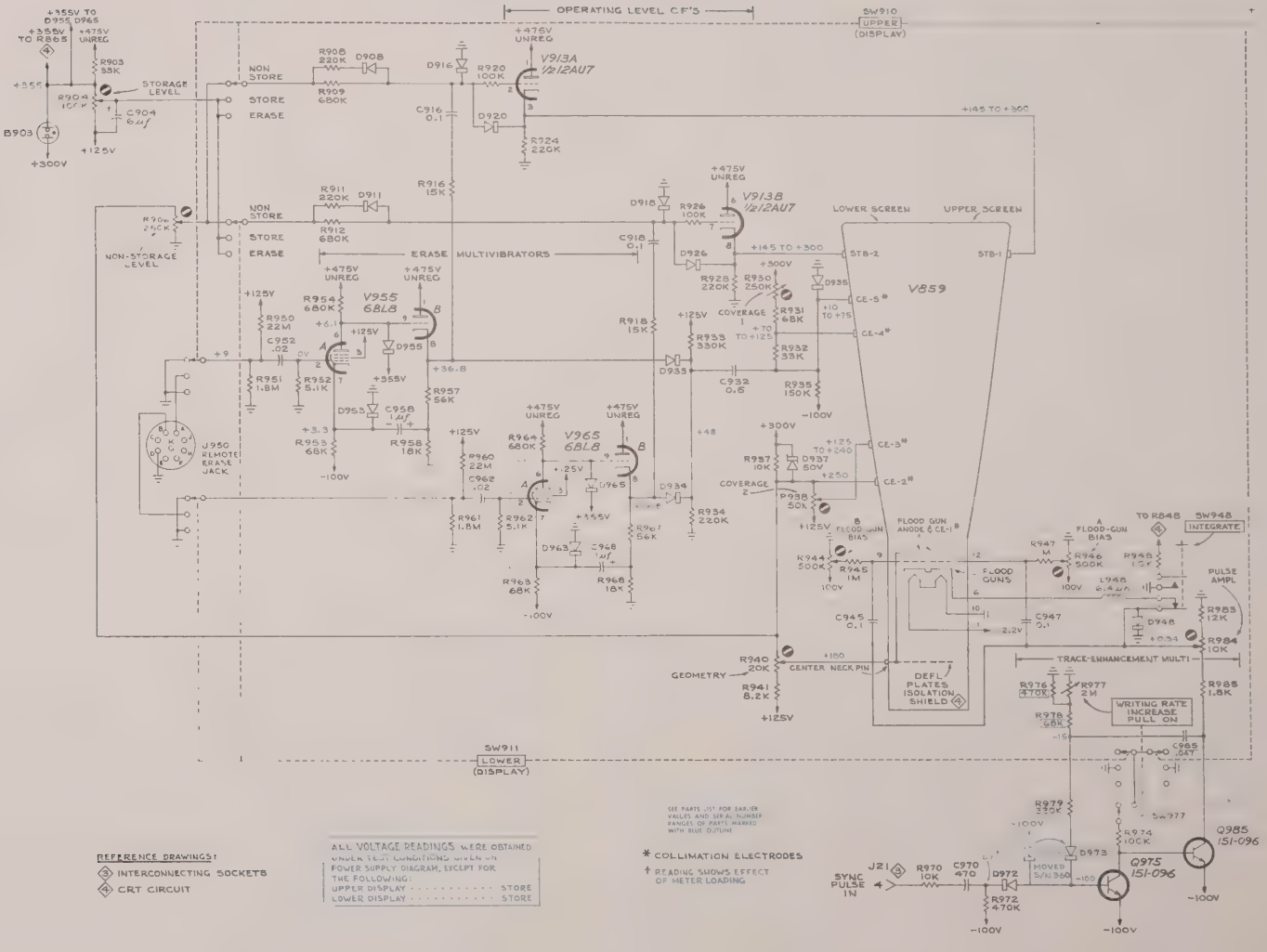
- (2) POWER SUPPLY
- (4) CRT CIRCUIT
- (6) STORAGE CIRCUIT

* INPUT AND OUTPUT SIGNALS WITH AMPLIFIER UNIT IN VERTICAL COMPARTMENT AND TIME-BASE UNIT IN HORIZONTAL COMPARTMENT

168 MRH


HV OSCILLATOR
HV RECTIFIERS
T801
1420V UNREG
RB01 680
CB01 .02
+300V
RB02 5.6K
RB03 1.7K
+78
V800 6CZ5
CB04 .1
RB07 4.7K
RB08 1K
CB03 .1
V832 5642
-3450
R831 10K
RB30 2M
RB31 1M
RB32 2M
RB33 1M
RB34 1M
RB35A 5.6M
RB35B 2.4M
RB35C 5.6M
RB35D 6.8M
RB35E 2.2M
RB36 22K
RB37 47K
CB30 .1
CB32 .1
CB37 .1
+400V
V822 5642
CB22 .0068
RB48 330K
R949
R849 22M
CB49 .1
R44 1.2M
R64 .47
R49 .01
R84 2.5M
RB42A 3.3M
RB42B 3.4M
RB42C 2.7M
RB42D 2.7M
R844 5M
FOCUS
C842 .0068
R846 2.2M
R850 22K
R851 100K
R852 27K
CB53 .0068
R853 470
R854 1M
+4V REGULATOR
+300V
RB13 100
RB15 470K
RB16 1K
V814A 1/2 12BH7
V814B 1/2 12BH7
-66V
+2.3
HIGH VOLTAGE
V859
TRACE ALIGNMENT
DEFLECTION PLATES ISOLATION SHIELD
ASTIGMATISM
TO R944
R864 250K
TO LEFT HAND DEFL. PLATE THRU R765 & D763
SW868 GATE (TRACE)
R865 4.7K
R867 4.7K
R868 4.7K
UNBLANKING PULSE
BLANKING VOLTAGE
R869 56K
B856
B857
6.3VAC FROM T601
-3300
REAR PANEL
EXT CRT CATHODE
GND
J878
J877
CRT CATHODE SELECTOR SW854
CHOPPED BLANKING
CHOPPED BLANKING PULSE
J11 24
J21 14 INTENSIFYING PULSE
ALL VOLTAGE READINGS WERE OBTAINED UNDER TEST CONDITIONS GIVEN ON POWER SUPPLY DIAGRAM.
REFERENCE DRAWINGS:
2 POWER SUPPLY
3 INTERCONNECTING SOCKETS
4 STORAGE CIRCUIT
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE


+125V
R870 39K
CAL AMPL
R871 4.7K
R872 50K
R873 6K
V884A 1/2 6BL8
V884B 1/2 6BL8
R879 1.0K
-150V
+300V
R883 2.2K
R878 2.49K
C878 .00
C884 .1
R876 15K
C876 .2
6.3V AC FROM TERM 9 T601
R877 18.2K
R885 17.8K
R886 1.78K
R887 178
R888 2
R890 1.78K
R891 78
R892 19.8
100V
10V
1V
.1V INTO 50Ω
100 mv
10 mv
1 mv
OFF
R898 255
CAL OUT
R899 0.25
-150V
1R
SW 870 CALIBRATOR
1F
REFERENCE DRAWING:
POWER SUPPLY
ALL VOLTAGE READINGS WERE OBTAINED UNDER TEST CONDITIONS GIVEN ON POWER SUPPLY DIAGRAM



TYPE RM564 STORAGE OSCILLOSCOPE

AA,

STORAGE CIRCUIT 6

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

TYPE R564 TENT SN 3990

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO·

D971	152-0141-02	Silicon	1N4152
D972	152-0141-02	Silicon	1N4152

M13,721/1068

TYPE RM564 TENT SN 3970

STANDARD ACCESSORIES CORRECTION

Section 6 Parts List and Schematics

Page 6-13 Standard Accessories

REPLACE: the present Ref No. 1 with the following:

161-0024-03	3970	1	CORD, power

M14,629/1168

TYPE R564 TENT SN 2900

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

D937	152-0150-00	1N3037B	1 w, 51 V, ±5%

M11,191/768

CALIBRATION PROCEDURE CORRECTIONS

SECTION 5 Calibration

Equipment Required

DELETE: Ammeter (listed as #13).

DELETE: Step 22 (omit step 22 altogether).

CHANGE: Step 23 to read as follows:

23. Adjust Storage Level

a. Reset the following controls:

INTENSITY	Counterclockwise
Time-Base MODE	Normal
DISPLAY	Non Store
TIME/DIV	1 msec

b. Connect a dc voltmeter (300 - Volt scale) between ground and pin 8 of V913 (lower storage-target backplate). (See Fig. 5-5)

c. Obtain a trace and adjust INTENSITY for normal display brightness. Adjust FOCUS & ASTIG for a well defined trace.

d. Switch time-base to SINGLE SWEEP.

e. Turn R904 (Storage Level) fully CCW.

f. Set both display switches to STORE.

g. Apply several single sweeps while adjusting R904 clockwise until the writing beam just begins to store. Erase screen and wait about 15 sec.

h. Apply single sweeps while rotating the Vertical POSITION back and forth.

i. Continue adjusting R904 in 5 Volt increments until the traces will store anywhere in the graticule area with breaks no longer than 1/8th inch. (see Fig. 5-6a) (Storage does not occur on the screen-separation line.)

j. Note and record the voltage reading on the meter. This is the retention threshold (Ert).

k. Continue to advance R904 in 5 Volt increments (erasing and waiting 15 sec) until the single-sweep traces start to spread into the background (Fig. 5-6b).